United States
Department of
Agriculture

Forest
Service

**Southwestern
Region**

Proposed Action for Four-Forest Restoration Initiative

Coconino and Kaibab National Forest, Coconino County, Arizona

Table of Contents

List of Tables

List of Figures

Overview

The Four-Forest Restoration Initiative (4FRI) is a planning effort designed to restore forest resiliency and function across four National Forests in Arizona including the Coconino, Kaibab, Apache-Sitgreaves and Tonto (figure 1). Due to the size of the landscape involved, at least two environmental analyses will be conducted. The first environmental analysis (figure 2) focuses on the Coconino National Forest (hereafter referred to as Coconino NF) and Kaibab National Forest (hereafter referred to as Kaibab NF) with a project area totaling approximately 988, 764 acres.

Within the 988,764 acre project area, the Forest Service is preparing an environmental impact statement (EIS) that proposes to conduct restoration activities on approximately 600,000 acres on the Coconino NF and Kaibab NF. Of this total, approximately 361,379 acres would be treated on the Coconino NF and 233,991 acres would be treated on the Kaibab NF. Restoration actions would be focused on the Flagstaff district with fewer acres included on the Mogollon Rim and Red Rock districts of the Coconino NF. On the Kaibab NF, activities would occur on the Williams and Tusayan districts (figure 3).

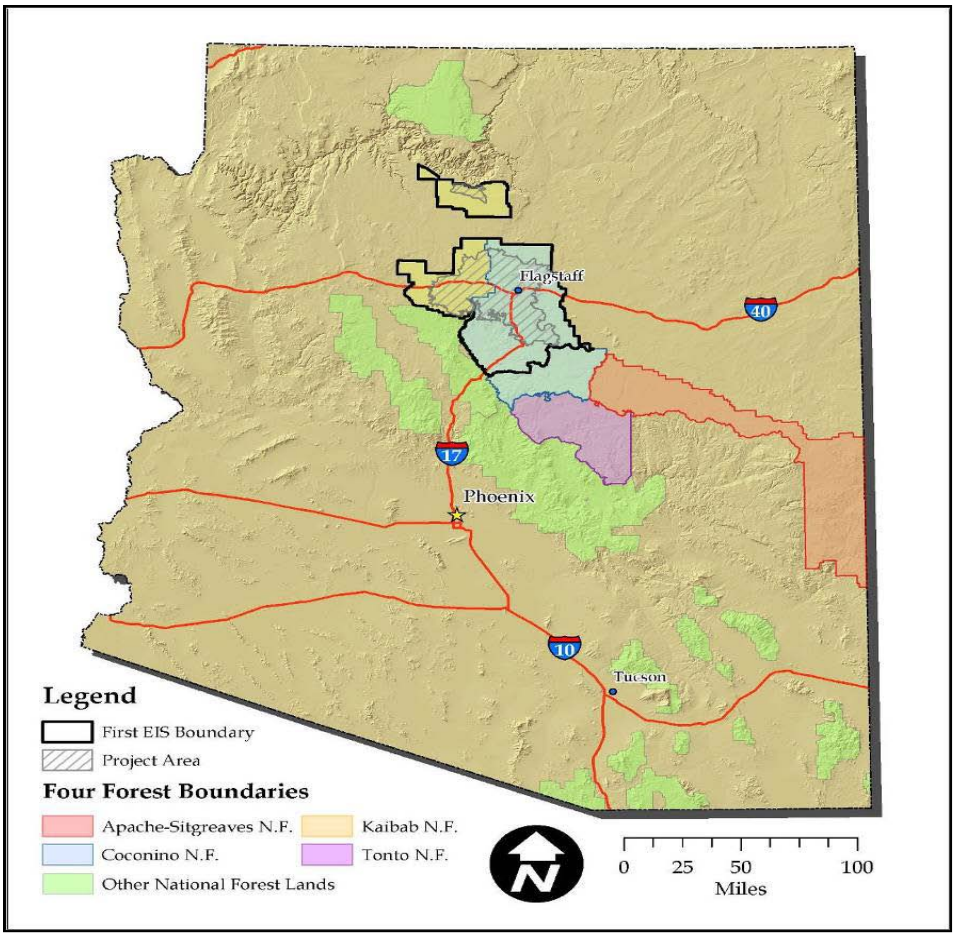

Figure 1. Four-Forest Restoration Initiative (4FRI) Vicinity Map

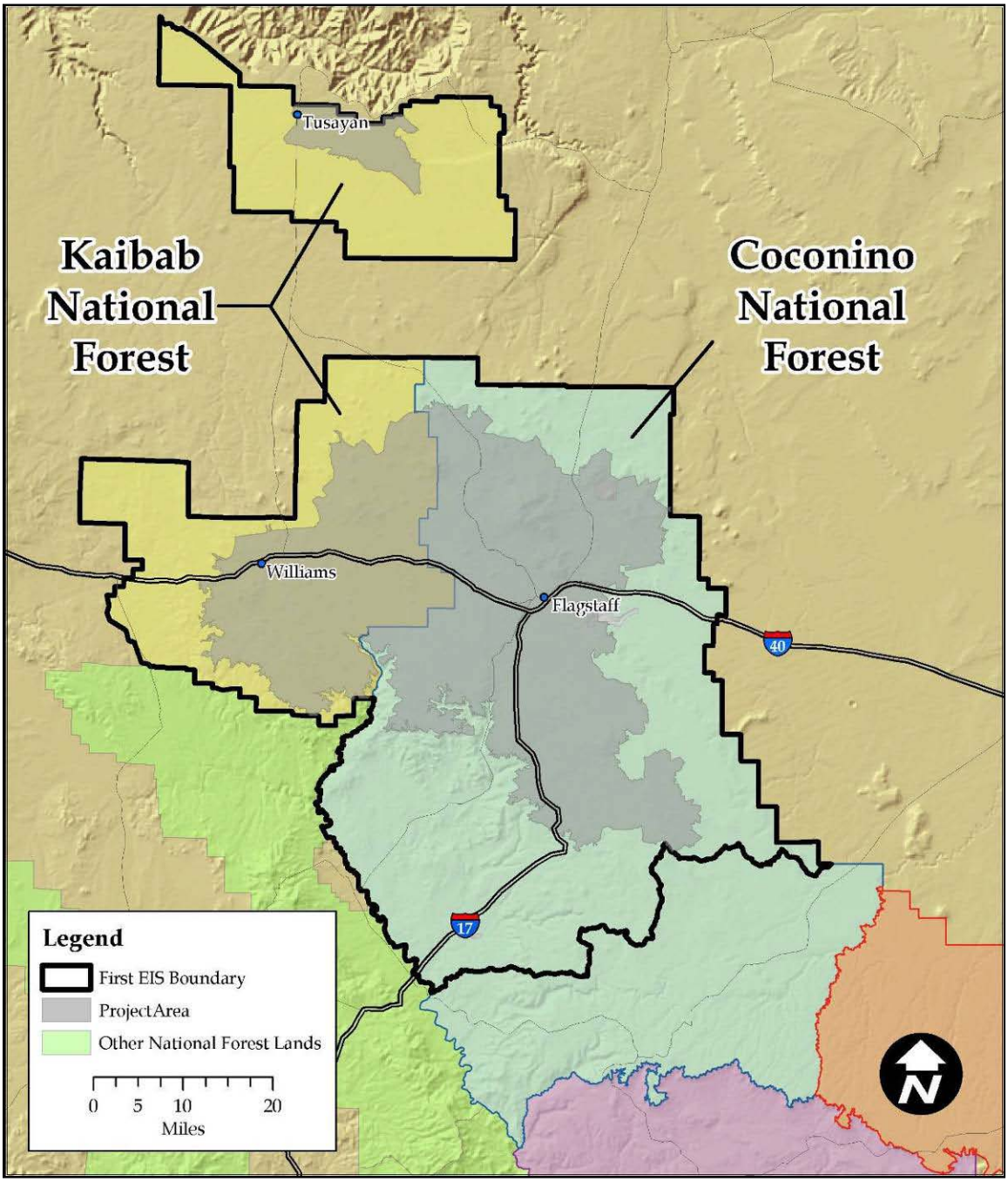

Figure 2. EIS and project area boundary on the Coconino NF and Kaibab NF

The objective of the project is to re-establish forest structure, pattern, and composition, which will lead to increased forest resiliency and function. Resiliency increases the ability of the ponderosa pine forest to survive natural disturbances such as insect and disease, fire, and climate change (FSM 2020.5). This project is expected to put the project area on a trajectory towards comprehensive, landscape-scale restoration with benefits that include improved vegetation biodiversity, wildlife habitat, soil productivity, and watershed function.

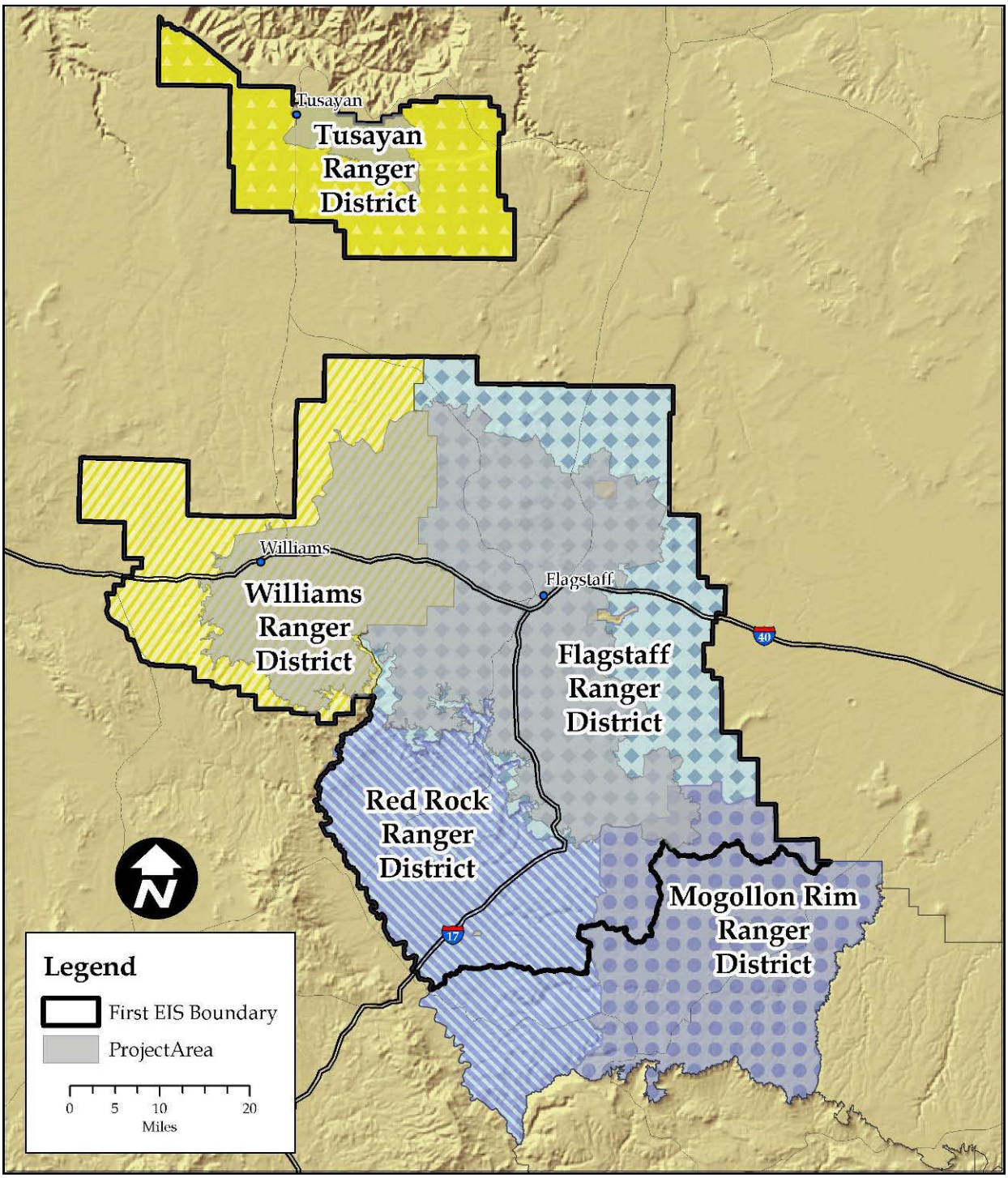

Figure 3. Coconino NF and Kaibab NF ranger districts within the project area

Background

Extensive research has demonstrated that current ponderosa pine forests of the Southwest are greatly altered in terms of forest structure, density, and ecological function. Most pine forests in the Southwest are at much higher risk of high intensity and severe fire than they were prior to European settlement (Covington 1993, Moore et al. 1999). A century ago the pine forests had widely-spaced large trees with a more open, herbaceous forest floor (Cooper 1960). These conditions were maintained by fairly frequent low-severity surface fires that did not kill the large trees (Fiedler et al. 1996). These fires occurred every 2 to 21 years and maintained an open canopy structure (Moir et al. 1997).

Fire suppression, cattle grazing, timber production, and general human habitation in and near the forests over the last 100 years interrupted fire's natural role in these fire-adapted ponderosa pine forests. As a result, the forests have shifted from naturally open conditions to high densities of small diameter trees (Covington and Moore 1994) dramatically increasing the size and severity of wildland fires (Swetnam and Betancourt 1998). The forests have become less resilient to natural disturbances and are vulnerable to large-scale disturbances such as changing climatic conditions (drought), fire, insect, and disease. In response to this, the Four-Forest Restoration Initiative (4 FRI) was created.

The 4FRI is a result of several years of planning and collaboration among interested parties, groups and organizations, state and local governments, and state and federal agencies. In 2007, the Arizona Forest Health Council completed the *Statewide Strategy to Restore Arizona's Forests*. The strategy's vision is to integrate knowledge and experience from science, community collaboration, and economics to identify the necessary steps to increase the rate and effectiveness of forest restoration across Arizona.

In February 2008, based on recommendations within the statewide strategy, the *Analysis of Small Diameter Wood Supply in Northern Arizona* (USDA et al. 2008*)* report was completed. This process demonstrated a level of "social agreement" on how much, where, and under what basic parameters mechanical thinning, as one restoration tool, could be used to accelerate restoration of the 2.4 million-acre ecosystem. In 2008, the Kaibab NF launched the Kaibab Forest Health Focus, a science-based, collaborative effort to guide future landscape-level forest restoration efforts.

In 2009, Title IV of the Omnibus Public Land Management Act authorized funding for the Collaborative Forest Landscape Restoration Fund (CFLR) to support landscape-scale restoration on National Forest System lands. CFLR objectives include reducing uncharacteristic wildfire and the associated management costs, supporting local and collaborative partnerships, supporting monitoring of restoration efforts, and supporting efforts that utilize forest products that benefit communities and offset treatment costs.

In an effort to further advance collaborative efforts and secure the necessary assistance, the Forest Service created a task force to work with the Forest Health Council. The purpose of the task force was to identify alternative approaches to accelerating forest restoration in northern Arizona. In an effort to move into on-the-ground implementation as quickly as possible, stakeholders representing individuals, state and federal agencies, local governments, the four national forests in northern Arizona, and the Forest Service's Southwestern Regional Office, moved forward with the four-forest initiative. The initiative received funding via CFLR in 2010.

In 2010, stakeholders and the Forest Service began refining the vision for ponderosa pine forest restoration across 2.4 million acres on four National Forests in northern Arizona: the Apache-Sitgreaves, Coconino, Kaibab, and Tonto National Forests. A sub-group of the 4FRI stakeholder group developed a comprehensive landscape restoration strategy for the Coconino NF and Kaibab NF which documented existing conditions, potential treatment areas and desired post-treatment conditions. The Forest Service used the landscape restoration strategy to inform the purpose and need and proposed action for this project.

4FRI History

- *Statewide Strategy to Restore Arizona's Forests (2007)*
- *Analysis of Small Diameter Wood Supply in Northern Arizona (2008)*
- *Kaibab Forest Health Focus (2008)*
- *Collaborative Forest Landscape Restoration Fund (CFLR) (2009)*
- *Landscape Restoration Strategy For The First Analysis Area (2010)*

Location

The 988, 764 acre project area is located on the Williams and Tusayan districts of the Kaibab NF and on the Flagstaff, Mogollon Rim and Red Rock districts of the Coconino NF (figure 3). Of the 988,764 acre total, approximately 380,000 acres have been excluded from this proposal as over 204, 000 acres are being analyzed in separate vegetation analyses; over 30,000 acres are located in special areas that include designated wilderness; and over 145,000 acres are non-Forest Service administered lands.

Due to the size of the project area, the 4 FRI team stratified the landscape into six restoration units (figure 4). A restoration unit (RU) is a contiguous geographic area that ranges from 46,000 acres to 335,000 acres in size. A need for change (vegetation structure, pattern, spatial arrangement, potential for destructive fire behavior and effects) was identified for each RU.

RU 1 and 2 include portions of the Flagstaff, Mogollon and Red Rock ranger districts (Coconino NF). RU 1 is generally located south of I-40 and east of I-17 and RU 2 is generally located west of I-17 and south of the Mogollon Rim. RU 3 includes portions of the Williams district (Kaibab NF), Flagstaff and Red Rock districts (Coconino NF) and is generally located south of I-40 and west of I-17. RU 4 includes portions of the Flagstaff district and the Williams district. It is generally located north of I-40 and west of Highway 180. Communities in the vicinity of proposed treatments include Flagstaff, Munds Park, Mormon Lake, Tusayan and Williams, Arizona.

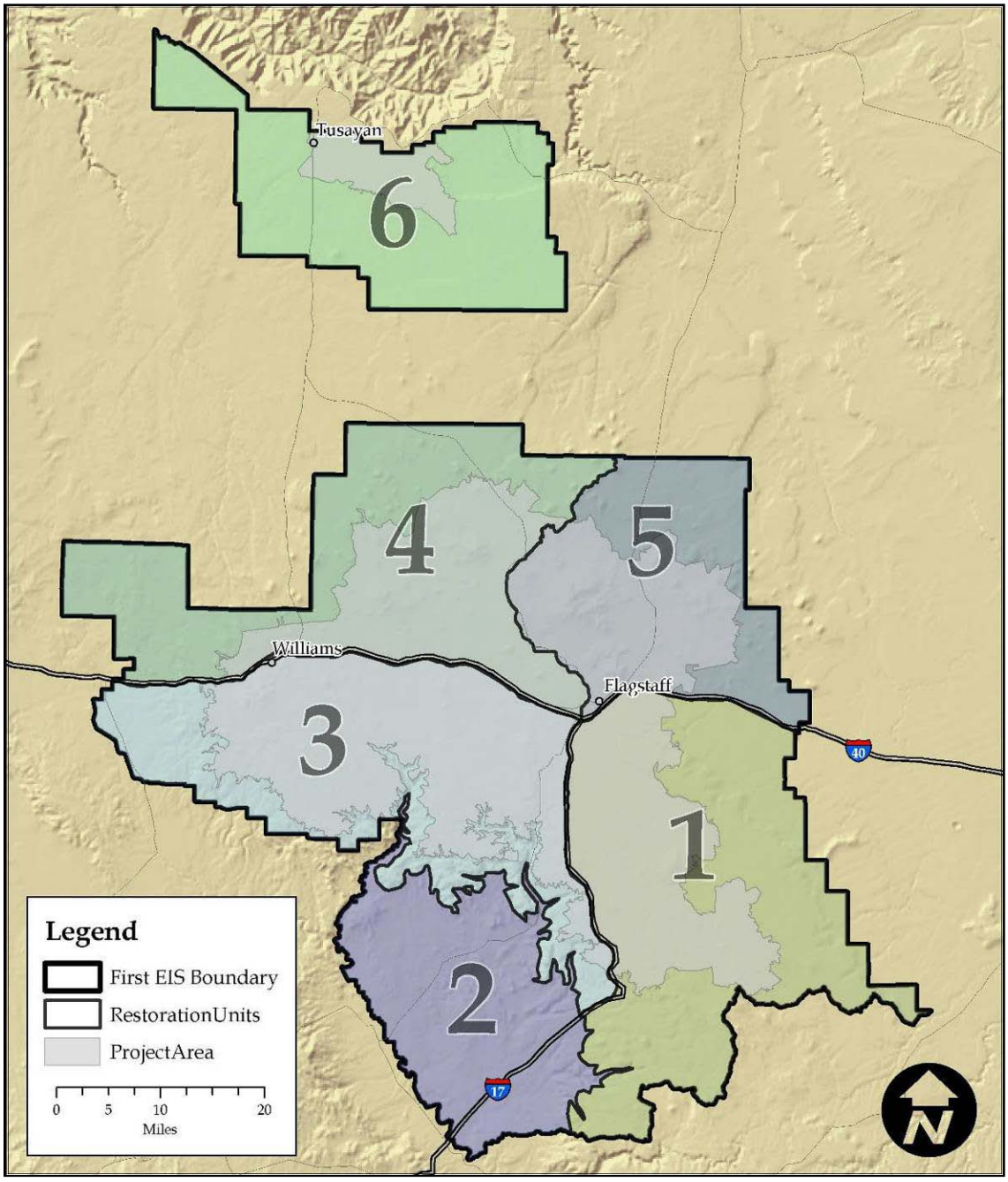

Figure 4. Restoration units (RU) within the project area

The team further stratified each RU into several sub-units that range from 4,000 to 109,000 acres in size. Both units (RU and sub-units) are based on 6th code watershed boundaries, state and forest transportation systems and the Forest's administrative boundaries (figure 5).

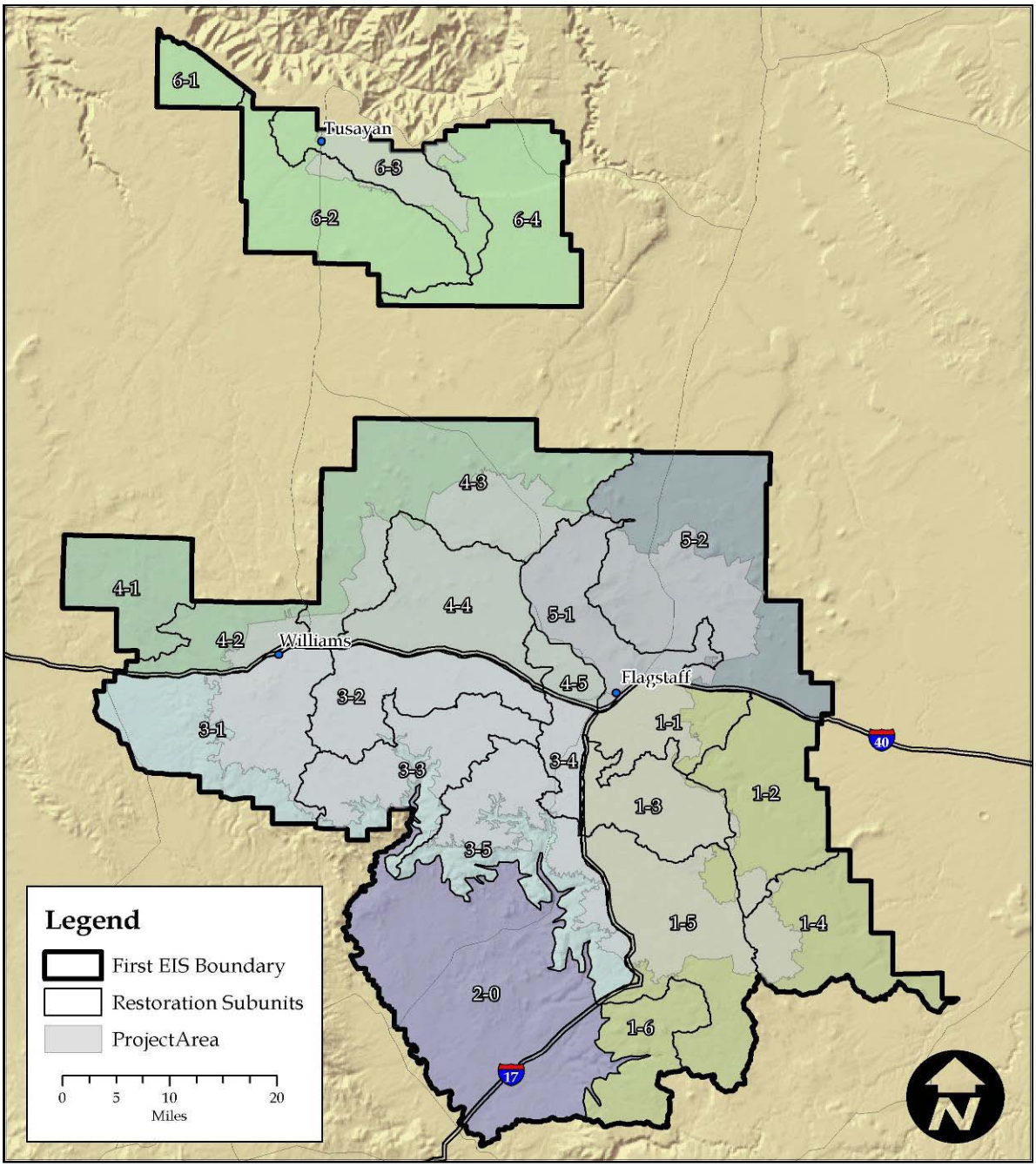

Figure 5. Restoration sub-units within the project area

Purpose and Need for Action

The purpose and need for proposing an action was determined by comparing the objectives and desired conditions in the Coconino NF and Kaibab NF Land Resource and Management Plans (forest plans) to the existing conditions related to forest resiliency and forest function. The results of the comparison are displayed in narrative, tables, and photographs; in summary, there is a need for:

- moving vegetation structure and diversity towards desired conditions by creating a mosaic of interspaces and tree groups of varying sizes and shapes
- moving towards a forest structure with all age and size classes represented as identified in the 1996 forest plan amendment for northern goshawk and Mexican spotted owl habitat
- managing for old age (pre-settlement) trees such that old forest structure is sustained over time across the landscape by moving towards forest plan old growth standards of 20 percent at a forest EMA scale
- improving forest health by reducing the potential for stand density-related mortality and by reducing the level of dwarf mistletoe infection
- moving towards desired conditions for vegetation diversity and composition by maintaining and promoting Gambel oak, aspen, grasslands, and pine-sage
- moving towards the desired condition of having a resilient forest by reducing the potential for undesirable fire behavior and its effects
- moving towards the desired condition of maintaining the mosaic of tree groups and interspaces with frequent, low-severity fire by having a forest structure that does not support wide-spread crown fire
- moving toward desired conditions in riparian ecosystems by having springs and seeps function at, or near, potential
- moving towards desired conditions for degraded ephemeral channels by restoring channel function
- moving towards restoring select closed and unauthorized roads to their natural condition by restoring soil function and understory species

Existing and Desired Conditions

Forest Structure

A century ago the pine forests were dominated by widely-spaced large trees with a more open, herbaceous forest floor (Cooper 1960). Typical historic tree group/patch size ranged from 0.1 to 0.75 acres in size, (2 to >40 trees) (White 1985). This historic range of variability condition for trees per acre on the Fort Valley Experimental Forest, near Flagstaff, Arizona, is estimated to average 23 to 56 trees per acre (Covington 1993).

Fires burned on a frequency ranging from 2 to 21 years (Weaver 1951; Cooper 1960; Fule 2003; Heinlein et al. 2005; Diggins 2010; Swnetnam and Baisan 1996; Fule et al. 1997), with the majority of acres burning with low-to-moderate severity surface fire. The herbaceous understory

fueled frequent fires started by lightning, and thinned and/or eliminated thickets of small trees keeping the forest open and park-like (Allen et al. 2002). This created a mosaic of grass, forbs, shrubs and trees. Under these conditions, the forest maintained its diversity and resiliency to fire and other natural disturbances. Today, human factors have led to a lack of re-occurring fire, which has resulted in a landscape that is highly departed from historic reference conditions.

Canopy Openings

In contrast to having a ponderosa pine ecosystem consisting of groups of trees with an open tree canopy density mixed with interspaces, approximately 75 percent of the ponderosa pine forest type within the project area has a moderately closed to closed tree canopy density (table 1). This indicates a continuous tree canopy with few canopy gaps and openings. An open tree canopy mixed with interspaces which mimic historical spatial patterns and provide for tree regeneration and the development of grass and forbs are lacking. There is a direct relationship between canopy openings and understory vegetation. About 99 percent of the vegetation diversity in Southwest ponderosa pine forests occurs as understory species (Laughlin and Abella 2007). Abella and Springer (2008) concluded that tree thinning was a viable management technique for increasing the vigor and richness of understory.

Table 1 displays the departure from the historic range of variability across the project area using canopy density as the analysis metric to estimate the continuity of the tree canopy. The desired condition is a ponderosa pine ecosystem consisting of groups of trees with an open tree canopy density mixed with interspaces. There is a need to use management strategies that promote tree regeneration and understory vegetation. There is a need to move towards the historic range of variability for tree canopy density and patterns of tree groups and interspaces.

Table 1. Current percent of ponderosa pine in project area by tree canopy density classification

Tree Canopy Density Classification	Percent of Project Area (%)
Open: 10% to 39%	22
Moderately Closed: 40% to 59%	29
Closed: 60%+	46
Unknown	3

Figures 6 and 7 compare the change in the ponderosa pine herbaceous understory in the Government Mountain area on the Kaibab NF in 1953 and 2010, a span of 57 years. At the time the photo in figure 6 was taken, there was still a healthy, contiguous herbaceous understory with a matrix of bunchgrass with little needle litter. A fire burning through this system would not have been able to move from crown to crown in the trees, but would have been a surface fire. Occasional and isolated torching of individual trees or clumps of trees would have occurred.

It is important to note that by 1953, the area had already experienced the impacts of approximately 70 years of varying degrees of livestock grazing and 43 years of fire suppression. This likely contributed to the number and size of trees present in figure 6. Note that the size of trees in figure 6 is small. There is no evidence of logging or evidence of high stumps that would indicates trees were cut by hand. This indicates that the area was much more open than in figure 7. In figure 7, the five trees in the foreground have matured. Younger trees now occupy what had been a meadow behind them. The needle litter at the surface has increased. Needle litter combined with the increasing shade from the matured trees caused a significant decrease in the surface vegetation. A fire moving through this system could move from tree crown to tree crown, potentially killing most of the trees in one fire.

The desired condition is to restore tree density and pattern to the natural range of variability, while meeting forest plan requirements for Mexican spotted owl (hereafter referred to as MSO) protected and target/threshold habitat and goshawk nest stands. Canopy gaps and interspaces would provide adequate space for the development of rooting zones for tree groups and an increase in the grass/forb understory. Canopy gaps and interspaces between tree groups or individuals, based on site productivity and soil type, would range from 10 percent on highly productive sites to as high as 90 percent on those soil types that have an open reference condition. Pre-settlement tree evidence would be used to help determine the historic range of variability in tree densities.

Figure 6. Government Mountain monitoring transect circa 1953

Figure 7. Government Mountain monitoring transect in 2010

Age and Size Class Diversity

Forest resiliency and diversity is dependent on the distribution of age and size classes. A balance of age and size classes across the landscape allows for a sustainable balance of regeneration, growth, mortality and decomposition. Currently, over 50 percent of the project area lacks age and size class diversity and is in an even-aged structure. The desired condition is to have a forest structure that represents all age classes necessary for a sustainable balance of regeneration, growth, mortality and decomposition. There is a need to implement un-even aged management strategies where appropriate[1]. Figure 8 displays a dense, even-aged forest structure that is common throughout the project area.

Figure 8. Example of a mid-aged, dense forest with trees that are the same age and size (even-aged) that is common throughout the project area

[1] Mexican spotted owl (MSO) protected/threshold habitats and goshawk nest habitats are managed for high-density, relatively uneven-aged stands.

Figure 9 displays a recently thinned stand that will progress towards the desired condition of having a ponderosa pine forest structure that is uneven-aged. This stand consists of groups of trees with an open tree canopy density mixed with interspaces and a robust herbaceous understory. Note the difference in the stand structure and understory vegetation displayed in figure 8 when compared to figure 9.

Figure 9. Ponderosa pine with groups, gaps and open canopies on the Coconino NF (Mountainaire project, approximately 1 year post-treatment)

Forest Structure in goshawk and MSO habitat

The Coconino NF and Kaibab NF forest plans include standards and guidelines that, once implemented, will move treated areas towards a forest structure with all age and size classes represented for all goshawk and MSO habitat types. Vegetation Structural Stage (VSS) is the metric used to describe existing and desired age and size classes. Table 2 displays the acres of goshawk and MSO habitat within the project area.

Table 2. Goshawk and MSO habitat within project area

Habitat Type	Acres
Goshawk Protected Fledgling Family Area (PFA), dispersal PFA and nest stands	30,608
Goshawk Foraging	364,939
Goshawk habitat total acres	**395,547**
MSO Protected Activity Area (PAC)	36,674
MSO Restricted	67,577
MSO Target/Threshold	8,713
MSO habitat total	**112,964**
Total Acres of goshawk and MSO habitat	**508,511**

Specific to the northern goshawk, forest plan guidelines incorporate direction for maximizing sustainable landscapes of old forest. The guidelines were designed to sustain a long-term (250 years or more) intermix of vegetation structural stages (VSS), ranging from newly regenerated to old-aged trees and forests. Reynolds et al. (1992) determined this is best accomplished with about 20 percent of a landscape in VSS 1 and VSS 2 (grass/forb, seedlings/saplings), 20 percent in VSS 3 (young forest), 20 percent in VSS 4 (mid-aged forest), 20 percent in VSS 5 (mature forest), and 20 percent in VSS 6 (old forest). Each VSS can vary by 3 percent (plus or minus). These proportions reflect forest development from cohort establishment through canopy closure to old forests.

Reynolds et al. (1992) based the VSS recommendations on the needs of goshawks and 14 key prey species. No single prey species is likely to be abundant enough to support goshawks, especially during winter and extreme weather. Providing the habitat conditions necessary to support 14 key species is expected to provide for goshawks regardless of what may be happening to any one individual prey species at any given time. Prey populations within goshawk foraging areas are expected to be abundant and sustainable when the mix of VSS classes is achieved along with interspaces, understory vegetation development and the maintenance of snags and logs.

Tables 3 and table 4 display the existing and desired forest structure within goshawk foraging habitat. The project area has approximately 364,939 acres of goshawk foraging habitat. Even-aged stand conditions (table 3) apply to 55 percent of the foraging habitat within the project area. This condition is only desirable in nesting stands. Approximately 45 percent of the foraging habitat is an uneven-aged stand condition (table 4). Of the even-aged stands, 57 percent is mid-aged to mature (VSS 4+) and 36 percent is young (VSS 3). With 84 percent of the stands in VSS 3 and VSS 4, this means the project area is deficit of mature and old forest (VSS 5 and 6) as well as seedlings and saplings (VSS 2).

Table 3. Goshawk foraging habitat even-aged stands in the project area (2010)

Vegetation Structural Stage (VSS)	Tree Diameter (dbh)	Even-Aged Existing % of Area	Forest Plan Desired %Distribution[2]
1 – Grass/Forb/Shrubs	0.0 – 0.9”	6	uneven-aged in all VSS classes
2 – Seedling/Sapling	1.0 – 4.9”	0	
3 – Young Forest	5.0 – 12”	36	
4 – Mid-age Forest	12.0 – 17.9”	48	
5 – Mature Forest	18.0 – 23.9”	8	
6 – Old Forest	24”+	1	

Table 4 compares the existing VSS to the desired condition of 20 percent of a landscape in VSS 1 and VSS 2 (grass/forb, seedlings/saplings), 20 percent in VSS 3 (young forest), 20 percent in VSS 4 (mid-aged forest), 20 percent in VSS 5 (mature forest), and 20 percent in VSS 6 (old forest). The table illustrates how the existing uneven-aged forest structure does not represent a balance of VSS classes. As a result, habitat components such as an intermix of vegetation structural stages are lacking or limited in most stands. VSS 3 (36 percent) and VSS 4 (32 percent) are over-represented and VSS 1 (0 percent), VSS 2 (2 percent), VSS 5 (13 percent) and VSS 6 (17 percent) are deficit relative to a balanced age/structure uneven-aged condition.

Table 4. Goshawk foraging habitat uneven-aged stands in the project area (2010)

Vegetation Structural Stage (VSS)	Tree Diameter (dbh)	Existing % of Area	Forest Plan Desired Distribution (%)
1 – Grass/Forb/Shrubs	0.0 – 0.9”	0	10
2 – Seedling/Sapling	1.0 – 4.9”	2	10
3 – Young Forest	5.0 – 12”	36	20
4 – Mid-age Forest	12.0 – 17.9”	32	20
5 – Mature Forest	18.0 – 23.9”	13	20
6 – Old Forest	24”+	17	20

Within the project area there is approximately 30,608 acres of goshawk PFA, dispersal PFA and nest (includes replacement nest stands) habitat. The forest plan desired distribution of VSS in PFAs is the same as described above (table 4) for forging habitat. The desired conditions for goshawk nest and replacement nest stands is to have a forest structure dominated by mature and old forest structure (VSS 5, 6) with a canopy cover of 50 percent or higher. Table 5 displays conditions similar to those found in foraging habitat. VSS 3 and 4 are over-represented and VSS 1, 2, 5 and 6 are deficit relative to a balanced age/structure uneven-aged condition. In terms of landscape ecology, these elements represent specific habitat components that are needed for goshawk prey species. An imbalance in these habitat components potentially decreases the ability

[2] The forest plan standards and guidelines do not describe desired even-aged stand conditions for goshawk foraging area habitat. The desired condition is to convert all foraging area even-aged stands to the uneven-aged structural conditions shown in table 4 and convert all goshawk PFA/nest stands to the desired uneven-aged structural conditions shown in table 5.

of goshawks to maintain their numbers over time. There is a need to manage for a balanced interspersion of age classes in goshawk foraging and PFA/nest stand habitat.

Table 5. Forest structure in goshawk PFA/nest stands in the project area (2010)

Vegetation Structural Stage (VSS)	Tree Diameter (dbh)	Existing % of Area	Forest Plan Desired %Distribution
1 – Grass/Forb/Shrubs	0.0 – 0.9”	2	10
2 – Seedling/Sapling	1.0 – 4.9”	1	10
3 – Young Forest	5.0 – 12”	35	20
4 – Mid-age Forest	12.0 – 17.9”	45	20
5 – Mature Forest	18.0 – 23.9”	11	20
6 – Old Forest	24”+	6	20

Forest structure for MSO pine-oak habitat is evaluated by comparing the percent stand density index (SDI) by size class to the desired percent of SDI by size class and trees per acre >18” dbh . SDI is a metric used to rate the potential for density related tree mortality. Table 6 displays that MSO habitat has an excess of the smaller size classes (12” to 18”) and is deficit in trees 18” to 24” dbh in restricted habitat and in target/threshold, a component of restricted habitat. MSO habitat is at least 50 percent deficit in the 24” + category. There is a need to implement uneven-aged management strategies and manage for high-density, relatively uneven-aged stands in MSO restricted habitat, including target/threshold habitats.

Table 6. Percent of the total existing stand density index (SDI) and trees per acre in MSO habitat (2010)

Stand Density Index (SDI) by dbh and Trees per Acre ≥18” dbh class	Existing Percent (%) SDI in MSO restricted habitat		Desired Percent (%) SDI and Trees Per Acre ≥ 18” dbh class
	Target/Threshold	Restricted (non-target/threshold)	
SDI – 12” to 18”	27	29	15
SDI – 18” to 24”	16	12	15
SDI – 24”+	7	6	15
TPA ≥18”	17.9	11.5	20

Old Growth

The forest plans define old growth as a condition of the forest having structural attributes based on the number of large trees per acre, basal area, canopy cover percent, dead standing trees, and down logs (USDA 1987 as amended 1996) (USDA 1988 as amended 1996). Ponderosa pine and pinyon juniper are the species identified for allocating old growth in this analysis.

Forest plan old growth standards state, “Until the forest plan is revised, allocate no less than 20 percent of each forested EMA to old growth” and, “Allocations will consist of landscape percentages meeting old growth conditions and not specific acres”. Old growth guidelines for both forests state, “All analyses should be at multiple scales - one scale above and one scale

below the ecosystem management areas (USDA 1987, as amended 1996; USDA 1988, as amended 1996).“

Four scales of analysis have been developed given the size of this project. The smallest scale is represented at the stand level with stands averaging 100 acres in size. The EMA is considered to be the restoration sub-unit. Sub-units range in size from 4,000 to 109,000 acres. The scale above the EMA is the restoration unit which ranges in size from 46,000 to 335,000 acres. The fourth scale for ponderosa pine type is the 508,511 acres of ponderosa pine within the project area. For pinyon-juniper type, it is the 23,316 acres of pinyon-juniper within the project area.

Allocations to old growth consist of landscape percentages meeting old growth conditions and not specific areas. The allocations for this project are independent of previous allocations that were part of other projects/analyses that overlap this project area. This is due to changes in forest conditions since the previous analyses and updates to the MSO and goshawk habitat classifications.

There are approximately 508,510 acres of ponderosa pine in the project area. Of this total, 195,338 acres meet old growth conditions. Old growth allocations are based on current conditions within the project area along with forest plan specific management direction. Currently, all restoration units meet or exceed the 20 percent minimum percentage (table 7) requirement. Table 8 displays ponderosa pine old growth allocations by restoration unit and forest.

For ponderosa pine, the old growth allocation acreage/percentage includes: 100 percent of MSO protected habitat; 100 percent of MSO target/threshold; 40 percent of MSO restricted habitat that is uneven-aged with low dwarf mistletoe infection; 80 percent of MSO restricted habitat that is even-aged, mid-aged to old with low dwarf mistletoe infection; 100 percent of goshawk nest stands; 40 percent of goshawk PFA and foraging areas that are uneven-aged with low dwarf mistletoe infection; and, 80 percent of goshawk PFA and foraging areas that are even-aged, mid-aged to old with low dwarf mistletoe infection. Most sites currently do not fully meet the minimum criteria for ponderosa pine old growth conditions as listed in the forest plans. However, the habitat types noted above are closest to meeting old growth conditions.

Table 7. Ponderosa pine old growth allocation acres and percent by restoration unit

Restoration Unit	Ponderosa pine total acres	Ponderosa pine old growth acres	Old growth percent (%)
1	145,072	65,146	45
3	128,746	46,525	36
4	135,096	48,605	36
5	58,408	24,720	42
6	41,188	10,342	25
Totals	**508,510**	**195,337**	**38 (average)**

Table 8. Ponderosa pine old growth allocation acres and percent by forest

Restoration Unit	Ponderosa pine total acres		Ponderosa pine old growth acres		Old growth percent (%)	
	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF
1	145,072	0	65,146	0	45	NA
3	58,104	70,642	21,429	25,096	37	36
4	55,926	79,170	17,922	30,683	32	39
5	58,408	0	24,720	0	42	NA
6	0	41,188	0	10,342	NA	25
Total	**317,510**	**191,000**	**129,217**	**66,121**	*	*

There are approximately 23,316 acres of pinyon-juniper within the project area (table 9). The old growth allocation includes approximately 15,540 acres (67 percent) of the total acres as these sites/acres are closest to the minimum criteria for old growth conditions (per the forest plan). The old growth allocation includes all sites that are classified within the mid-aged to old vegetation structural stages. Most sites currently do not fully meet the minimum criteria.

Table 9. Pinyon-juniper old growth allocation acres and percent by forest

Restoration Unit	Pinyon-juniper total acres		Pinyon-juniper old growth acres		Pinyon-juniper old growth percent (%)	
	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF
1	1,141	0	525	0	46%	NA
3	832	3,201	356	1,747	39%	55%
4	42	7,123	42	4,116	100%	58%
5	8,771	0	7,302	0	83%	NA
6	0	2,206	0	1,452	NA	66%
Total	**10,786**	**12,530**	**8,225**	**7,315**	*	*

In ponderosa pine, there is a need to manage sites allocated as old growth towards desired old growth characteristics. Where management occurs within the pinyon-juniper cover type, there is a need to maintain the old growth characteristics within the sites allocated as old growth.

Forest Health - Stand Density

Forest health is defined by the vigor and condition of the forest stands and the presence of insects and disease that affect the sustainability of the forest. In the project area, dense stands of young to mid-aged trees (see table 4) have reduced tree growth and health to the point there is a high risk of tree mortality in the larger size classes. The potential for density-related mortality is measured through stand density index (SDI) and basal area (BA). Table 10 displays the existing and desired percent maximum SDI and BA within goshawk and MSO habitat in the project area. The table also displays existing and desired conditions for snags and course woody debris, two key components of wildlife habitat.

Table 10. Existing and desired condition for stand density, snags and course woody debris (CWD) by habitat stratum

Habitat Stratum	Existing Acres	Existing Condition BA Average	Desired Condition BA Range	Existing Condition SDI % of Maximum	Desired Condition SDI % of Maximum	Existing Snags 12"-18" per Acre	Existing Snags 18"+ per Acre	Desired Snags 18" + Per Acre	Existing CWD Tons Per Acre	Desired CWD Tons Per Acre
Goshawk										
PFA (including nest stands)	30,608	121	70-80	51	25-40	N/A	0.4	2.0	3.9	5-7
Foraging	364,939	113	50-70	49	15-35	N/A	0.4	2.0	3.2	5-7
MSO - Ponderosa Pine-oak										
Protected	36,674	150	NA	72	NA	2.8	0.6	2.0+	5.4	5-7
Restricted: Threshhold/ Target Threshhold	8,713	162	150-170	84	NA	2.4	0.6	2.0+	5.3	5-7
Restricted Other	67,577	134	70-90	69	25-40	1.8	0.4	2.0	3.8	5-7

Table 10 displays that the desired density conditions are not being met in a majority of the project area[3]. In goshawk habitat, stand conditions are on a trajectory towards density-related mortality. In MSO habitat, only restricted and target threshold meet desired conditions for stand density. In all habitat types, snags and course woody debris are deficit from the guidance in our forest plans. These are key elements necessary to maintain a suite of prey species for MSO. In addition, over 75 species of birds, mammals, reptiles, amphibians and many invertebrate species use snags and course woody debris as nesting, rooting, feeding, loafing and catching sites. The desired condition is to improve forest health by reducing the potential for density related mortality and move towards forest plan desired conditions for snags and course woody debris. There is a need to reduce stand densities in all habitats except MSO restricted and target threshold.

[3] SDI calculation excludes MSO protected and restricted threshold and target threshold habitat for a total of 45,387 acres where SDI is not applicable.

Insect and Disease

Ponderosa pine is attacked and killed by several different bark beetles in the genera *Dendroctonus* and *Ips*. It can be difficult to discern what species initiated the attack. In the project area, bark beetle activity in ponderosa pine currently appears to be at endemic levels.

Dwarf mistletoe infection in ponderosa pine is common throughout the project area. Mistletoe infected trees slowly weaken, experience growth loss, and eventually die (Lynch et al. 2008). Approximately 25 to 35 percent of the project area has some level of infection ranging from light to extreme. Although infection is present in the project area, the desired condition is to have a varied level of mistletoe across the landscape that is comparable with historic reference conditions. There is a need to move towards historic reference conditions while still providing nesting, resting, foraging and catching sites for birds and mammals including Abert's squirrels. There is a need to reduce (but not eliminate) the level of dwarf mistletoe infection.

Vegetation Diversity and Composition

Vegetation diversity throughout the project area has declined (USDA 2009). Gambel oak, a sub-type within ponderosa pine, is important to many wildlife species as it provides important nesting and foraging habitat. A lack of fire, which ultimately caused increased stand densities, has allowed Gambel oak to become overtopped by fast growing ponderosa pine (figure 10). The desired condition is to develop and maintain a variety of oak size classes and forms, where they occur. Oak should range from shrubby thickets and pole-sized clumps to large trees across the landscape. There is a need to stimulate new growth and maintain growth in large-diameter trees.

Figure 10. Ponderosa pine overtopping of Gambel oak in the Bar-M (Coconino NF) portion of the project area

There are approximately 7,700 acres of aspen in the project area. Aspen is an early seral component of the ponderosa pine ecosystem and a species that provides for habitat diversity. Aspen is dying or rapidly declining on both forests due to the combined effects of conifer encroachment, browsing, insect, disease, severe weather events, and lack of fire disturbance (USDA 2008 2009). A study by Fairweather et al. (2007) on the Coconino NF indicates that aspen on low-elevation dry sites (<7500 ft) has sustained 95 percent mortality since 2000. Mortality on these sites is expected to continue as many live trees currently have only 10 to 30 percent of their original crown. The desired condition is to maintain and/or regenerate aspen. Where possible, there is a need to stimulate growth and increase individual recruitment of aspen. Figure 11 portrays an unhealthy aspen stand within the project area.

Figure 11. Existing condition of aspen in the vicinity of Government Prairie, Kaibab NF

There are approximately 66,630 acres of grasslands (which includes wet and dry meadows) within the project area. Grasslands provide valuable habitat to many wildlife species including pronghorn antelope, birds, and small mammals. Historically (late 1800's), grassland communities had less than 10 percent tree cover until past actions such as grazing, logging and fire suppression reduced or eliminated the vegetation necessary to carry low intensity fires. This altered the natural fire regimes and allowed uncharacteristically high invasion by conifers to take place.

Over half of the total grassland acres across the Coconino NF and Kaibab NF have become encroached with trees and converted to forest. An assessment completed in 2008 found that within ponderosa pine on the Coconino NF, grasslands have decreased from approximately 8 to 3 percent since historic conditions (generally pre-1900). On the Kaibab NF, grasslands have decreased from approximately 15 percent to 7 percent. Figures 12 and 13 compare grassland

conditions in the Fern Mountain (Hart Prairie) area from 1880 to 1980 (USDA Forest Service, unpublished data). The desired condition is to move towards the historic range of variability. Tree canopy cover would range from 0 to 9 percent. Fire would function as a natural disturbance across the landscape without causing loss to ecosystem function or to human safety, lives, and values. There is a need to reduce (and in some cases remove) tree encroachment which has reduced the size and function of landscapes that were historically grasslands.

Figure 12. Fern Mountain (Hart Prairie) grassland circa 1880s

Figure 13. Fern Mountain (Hart Prairie) grassland encroachment circa 1980s

Big sage and ponderosa pine co-occur on approximately 16,000 acres of the Tusayan district (Kaibab NF, RU 6) portion of the project area. Pine-sage provides valuable habitat for several species of wildlife including migratory birds. Shrub species that occur with sage and provide further diversity include Fendler's ceanothus, mountain mahogany, snakeweed, bitter brush, Oregon boxleaf and Gambel oak. Sage cover under ponderosa pine varies from 0 percent cover, where it burned with moderate to high intensity surface fire, to well over 35 percent cover in areas where fire has been excluded. Sage occurs as shrub fields where sage is the overstory, in drainage bottoms, and as an understory species beneath ponderosa pine. The desired condition for the pine/sage understory community is to have a shifting mosaic of sagebrush with a mix of age classes averaging from 3 to 5 percent cover. With other shrub canopies combined, the percent cover should average around 9 to 14 percent under a 25 to 30 percent canopy of ponderosa pine. The mosaic pattern would be largely regulated by low-intensity fires. There would be small areas that would occasionally experience moderate to high severity fire as a result of woody fuel buildup from localized shrub or tree mortality. On approximately 40 percent of the pine-sage cover type, there is a need to retain vegetation age class diversity in big sage and promote a shifting mosaic of shrub cover.

Figure 14. Pine encroachment in big sage on the Tusayan district (Kaibab NF)

Figure 14 displays the existing condition in which saplings and mid-aged trees are encroaching on big sage. The cover of big sage is many times greater than the desired condition. Figure 15 displays a post-treatment desired condition approximately 6 years after a low intensity prescribed fire. This area is just south of the town of Tusayan, Arizona. Sagebrush and pine are both present in various age classes, along with a diversity of other vegetation and an herbaceous layer. This image shows the scarcity of fine, herbaceous fuels within the sagebrush clumps, which help to minimize the effects of fire (Tisdale and Hironaka 1981 in McArthur and Taylor 2004).

Figure 15. Post-treatment condition in pine-sage on the Tusayan district (Kaibab NF)

Fire Ecology

Approximately 41 percent of the project area has the potential to sustain crown fire, about 58 percent has the potential for surface fire, and 1 percent has no fire potential (table 11, figure18). Modeling used to display existing potential fire behavior utilized weather and fuel parameters that occurred during the Schultz Fire (Coconino NF, 2010). These weather conditions, while capable of supporting extreme fire behavior, are not unusual and were used to identify those areas which are at greatest risk of undesirable fire behavior and effects.

Crown fire generally produces 100 percent mortality in ponderosa pine by consuming the crowns of trees. Crown fire can be active or passive. Active crown fire advances from crown to crown in the tops of trees or shrubs (NWCG 2008). A passive crown fire is a fire in the crowns of trees, but only individual trees or groups of trees torch. Passive crown fire that is ignited in forests with interlocking crowns and/or low crown base heights may readily become active crown fire in more extreme weather situations. With a delay of more than 20 years between fires or treatments (a delay in the fire-return interval), areas of passive crown fire may transition to having the potential for active crown fire. The current fire-return interval is approximately 43 years, about four times longer than the desired fire-return interval which is between 2 and 21 years.

Figure 16 displays dense forest conditions (numerous trees with interlocking crowns) that are common within the project area. This densely-forested condition would support active crown fire. Even without crown fire, a high intensity surface fire burning though this area could scorch the canopy sufficiently to cause widespread mortality.

Figure 16. Dense forested condition on the Coconino NF with high crown fire potential

Figure 17 (below) shows a duff cone which is a build-up of needles, bark, and other litter that has accumulated around the base of a large tree due to a lack of fire. Such cones may smolder for extended periods of time and damage the cambium of the tree. This would make the tree more vulnerable to other stressors (drought, insects, and disease).

Figure 17. Accumulated duff and litter under a large tree near Elk Park (Coconino NF)

Canopy bulk density and canopy base height are forest structure parameters used to measure the potential for crown fire. Canopy bulk density is defined as the mass of available canopy fuel per unit volume (Scott and Reinhardt 2001). The harder it is to see the sky though the canopy when you are looking up through it, the denser (higher) the canopy bulk density. Higher canopy bulk densities means that fire can easily move through the crowns of trees. In addition, higher canopy bulk densities mean there are more fuels to burn. With more fuels, fire intensity would be influenced. Currently, canopy bulk density in the ponderosa pine of the project area ranges from 0.028 to 0.35 kg/m3. Approximately 61 percent of the pine has a canopy bulk density rating that is greater than .05 kg/m3. The desired condition is to have canopy bulk density below .05 kg/m3 in ponderosa pine.

The canopy base height of a stand is the lowest height above the ground at which there is a sufficient amount of canopy fuel to propagate fire vertically into the canopy (Scott and Reinhardt, 2001). The lower the canopy base height, the easier is for crown fire to initiate (Van Wagner, 1977). Currently, canopy base heights in the project area average approximately 15 feet. The desired condition is to have average stand canopy base height above 18 feet. It takes only one tree with a low crown base height to initiate a crown fire in a stand.

Overall, the desired condition is to have fire, as a disturbance process, maintain a mosaic of diverse native plant communities. No more than 10 percent of the project area should be prone to crown fire. When crown fire does occur, it should be mostly passive crown fire, occurring in single trees, groups, or clumps, or areas where there had been mortality (wind throw, insects, etc.) Fire would function as a natural disturbance within the ecosystem without causing loss to ecosystem function or to human safety, lives and values. Overtime, conditions would allow managers to use wildfire and prescribed fire to maintain the area as a functioning ecosystem. There is a need to reduce canopy bulk density and raise canopy base height in order to reduce the potential for crown fire and the potential for high intensity surface fire (in the more productive forested areas where canopy bulk density will be greater). Table 11 summarizes existing and desired conditions for fire risk. Figure 18 displays the current crown and surface fire potential within the project area.

Table 11. Existing and desired fire potential in 4FRI ponderosa pine project area

Evaluation Criteria	Existing Condition	Desired Conditions
Potential crown fire (%)	41	5 to 10
Canopy Base Height (ft)	15	>18
Canopy Bulk Density (kg/m3)	0.028 to 0.35	<.05
Potential surface fire (%)	58	80 to 90

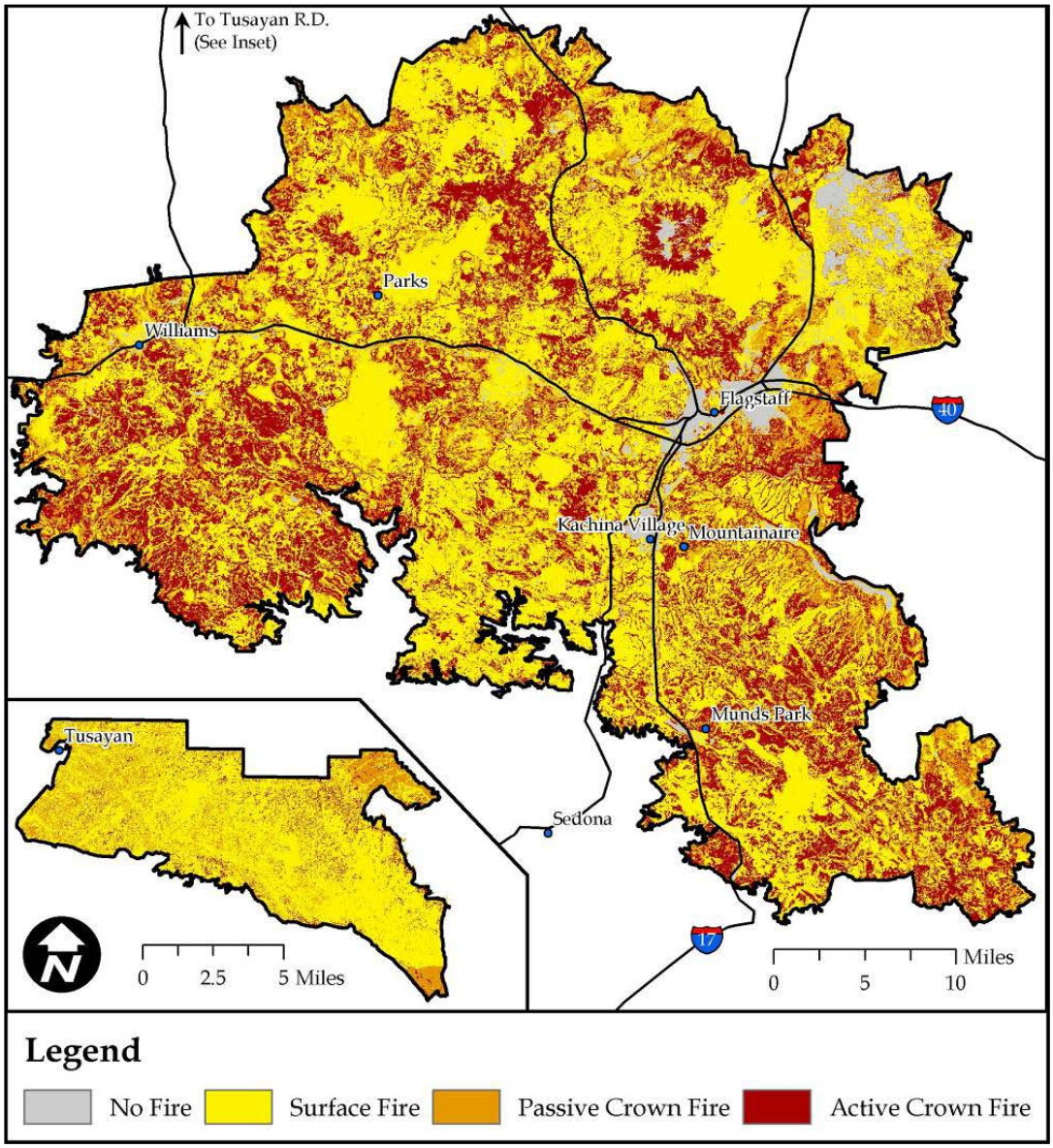

Figure 18. Current crown and surface fire potential in the project area

Fire Regime Condition Class

Fire Regime/Condition Class (FRCC) is a coarse-scale evaluation protocol that was developed to support planning and risk assessments (Schmidt et al.2002, Hann et al.2004). FRCC assessments determine how departed a landscape's fire regime is from its historic fire regime. Across the entire analysis area, 75 percent is currently rated as in condition class 3. This indicates the fire regime is significantly departed from historical ranges (table 12). In a condition class 3, the risk of losing

key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals resulting in dramatic alterations to fire size, intensity, severity, landscape patterns, and/or vegetation attributes. The desired condition is to have 99 percent of the project area in FRCC 1. The remaining 1percent of the area is represented by parking areas, administrative sites, road rights-of-ways and other features which can be in FRCC 3. In FRCC 1, fire regimes would be within historical ranges, and the risk of losing key ecosystem components would be low. Vegetation, fuels, and natural disturbances would be intact and functioning within historical ranges. There is a need to reduce the percent of area in FRCC 3 and move the fire regimes towards FRCC 1.

Table 12. Existing and desired fire regime/condition class

Fire Regime Condition Class (FRCC)	Existing Condition (% of total area)	Desired Condition (% of total area)
FRCC 1	3	99
FRCC 2	22	0
FRCC 3	75	1

Ecological Processes and Function

Springs and Seeps

Springs and seeps play an important role on the landscape for hydrological function of watersheds; and, they are very important for wildlife and plant diversity. Most springs and seeps in the project area have reduced function from drought, lack of fire, and closed forest canopies which increase evapotranspiration. Excessive disturbance can result in these features becoming non-functional (USDA 2008, 2009). Fifty-one developed springs on the Coconino NF are not functioning at or near potential and 27 springs on the Kaibab NF have reduced function.

Figures 19 is a photo of Babbitt Spring which has an impaired function. Babbitt Spring is located in the Lake Mary watershed on the Flagstaff district (Coconino NF). The impaired function is displayed by the headcut in the spring outflow, the encroachment of ponderosa pine into the spring site, and the lack of riparian vegetation that is normally associated with a functioning riparian site.

The desired condition for springs and seeps is to have the necessary soil, water, and vegetation attributes to be healthy and functioning at or near potential. Water flow patterns, recharge rates, and geochemistry are similar to historic levels and persist over time. Water quality and quantity maintain native aquatic and riparian habitat and water for wildlife and designated beneficial uses, consistent with water rights and site capability. Plant distribution and occurrence are resilient to natural disturbances. Figures 20 and 21 are examples of restoration treatment desired conditions.

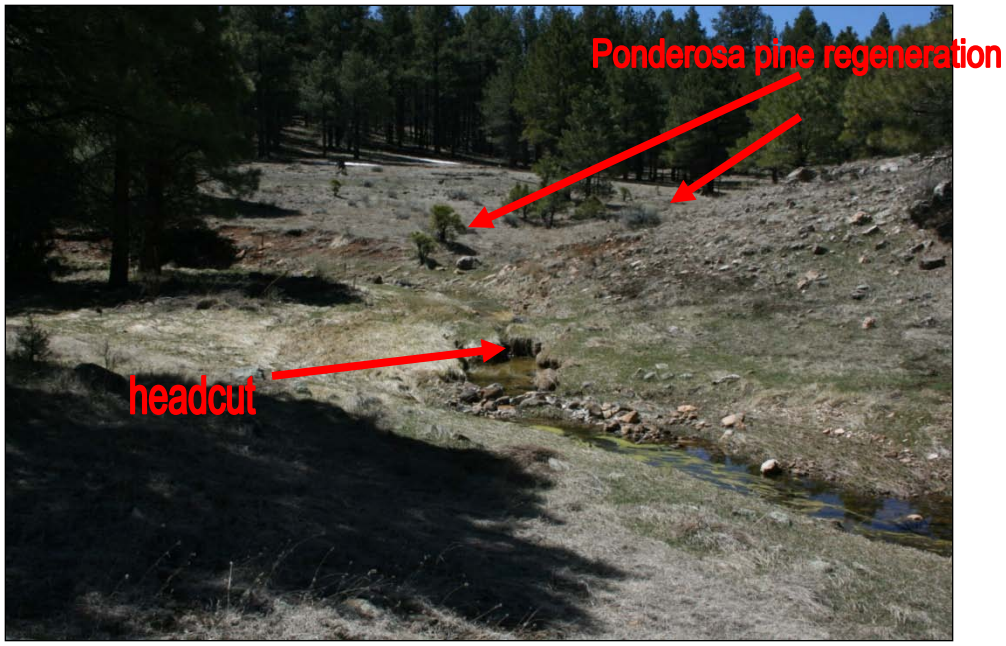

Figure 19. Degraded Babbitt Spring on the Coconino NF

Figure 20. Restored Hoxworth Spring (Coconino NF)

Figure 21. Hoxworth Spring restoration with protective fencing (Coconino NF)

Figure 20 displays Hoxworth Spring that is located approximately 3 miles upstream from Babbitt Spring. At this site, Hoxworth Spring has been restored through protective fencing from wild ungulates. Note the difference in vegetative composition, the overhanging banks in the springs outflow, the lack of headcutting at the site and the lack of trees in the meadow/spring site that provide for a functioning spring site. Figure 21 displays a fenceline contrast between the grazed and ungrazed portion of Hoxworth Spring.

Ephemeral Streams

Ephemeral streams are important for hydrological function of watersheds and provide important seasonal habitat for a variety of wildlife, in particular, migratory birds and dispersing amphibians. On the Coconino NF, approximately 36 miles of channels are heavily eroded with excessive bare ground, denuded vegetation, and head cuts. Of the total miles, approximately 6 miles are riparian streams and 30 miles are non-riparian streams. The Kaibab NF has approximately 7 miles of channels in this condition and all are non-riparian reaches.

Figures 22 and figure 23 show the pre-treatment and post-restoration treatment condition of a degraded ephemeral/riparian channel. Figure 22 displays the Hoxworth Spring drainage below the spring that is a degraded ephemeral/riparian channel. The photo shows an active headcut and lateral bank cutting with resulting accelerated erosion rates. The left-hand side of figure 23 shows the channel immediately after re-contouring. The treatment removed the headcut and lateral bank cutting. The tan strips in the photo are erosion mat applied to limit sediment production and provide mulch to aid in native seed establishment. The fence is an ungulate-proof fence that is in place to protect vegetation that is becoming established. The right-hand side of the figure shows the site condition one year after treatment with new vegetation occupying the site.

The desired condition is to restore the functionality of both springs and ephemeral streams. On some springs and channels there is a need to maintain and promote existing vegetation. On others there is a need to reduce tree encroachment, the presence of noxious weeds and limit the potential for future disturbance. On all springs and streams and channels, there is a need to return fire, a natural disturbance processes, to the system.

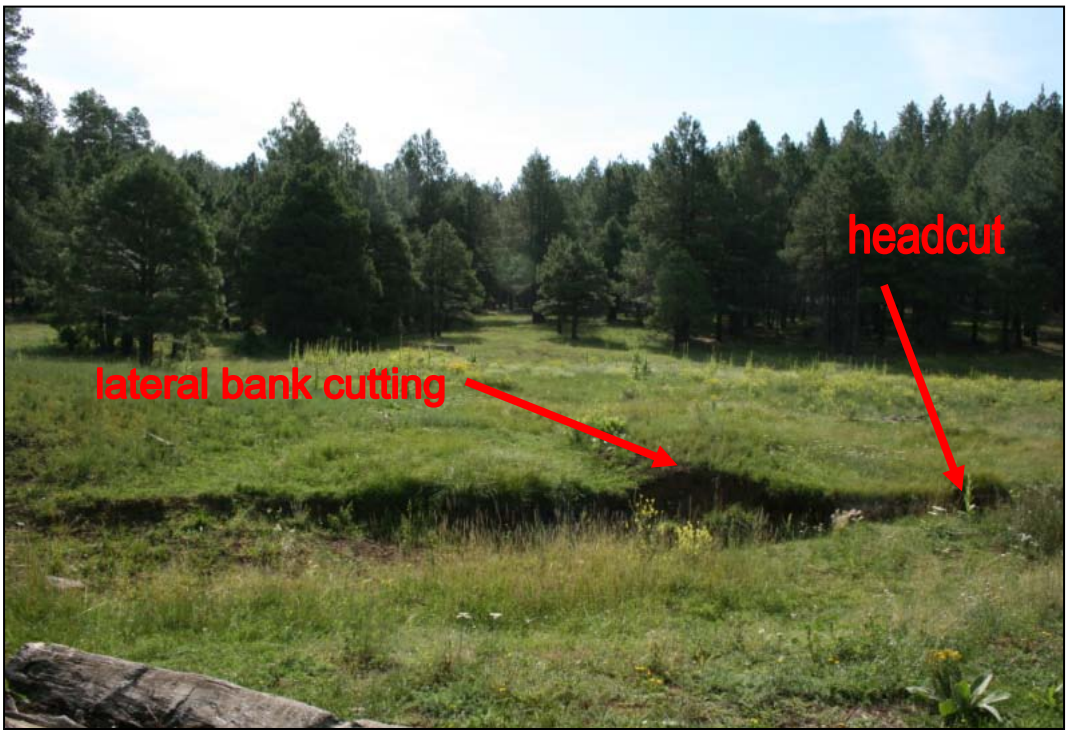

Figure 22. Degraded ephemeral/riparian channel in the Hoxswoth Spring drainage (Coconino NF)

Figure 23. Restored Hoxworth Spring drainage immediately post treatment (photo on left) and 1 year post-treatment (photo on the right)

Roads and Unauthorized Routes

Both forests have identified the needed road system for public and administrative motorized use through the Travel Management Rule (TMR) process. As a precursor to the TMR process, the Coconino NF conducted four formal Roads Analysis Processes (RAPs) including the forest-wide RAP for Passenger Car Roads (MLs 3, 4 and 5), the East Clear Creek RAP, the Anderson Mesa RAP, and the Mountainaire RAP. The RAPs identified resource risks and access benefits associated with all roads. Resource risk included impacts to soil and water resources and watershed function from roads that are eroding and contributing sediment. As part of the risk/benefit evaluation process, the RAPs identified roads that should be closed to public travel, decommissioned, or considered for other uses because they were no longer needed to meet resource management objectives (USDA 2010). A review of 2010 data indicated there is a need to decommission approximately 941 miles of existing system and unauthorized roads. These roads are not proposed for designation for public motorized use or currently needed for administrative use on the Coconino NF.

As a precursor to the TMR process, the Kaibab NF completed a Travel Analysis Process (TAP) report on the Tusayan district in 2008 (USDA 2008) and on the Williams district in 2010 (USDA 2010). Similar to the Coconino process, the TAPs identified resource risks and access benefits associated with all roads. A review of Kaibab NF data indicates approximately 170 miles of unauthorized roads (often referred to as user-created routes) are recommended for decommissioning.

The desired condition is to have soils in satisfactory condition so that the soil can resist erosion, recycle nutrients, and absorb water. Understory species (e.g., grasses, forbs, and shrubs) diversity would be consistent with site potential and provide for infiltration of water and reduction of accelerated erosion. The understory would have a variety of heights of cool and warm season vegetation. There is a need to decommission the roads that have been identified by the forests and use management strategies and road maintenance techniques (including restoration of drainage features) that moves towards restoring road prisms (as possible and practical) to their natural condition.

In addition to the need for decommissioning roads, there is a need to have adequate access to the project area for implementation. A portion of the open, existing road system that would be used to access the project has resource or health and human safety concerns. In some parts of the project area, there are no existing roads that could provide access to treatments, or the existing roads that are in place are managed as closed. There is a need to upgrade roads which have resource or health and human safety concerns, construct temporary roads, and temporarily open existing closed roads. Once the project is completed, there is a need to decommission the temporary roads and closed roads.

Proposed Action Development

The Notice of Intent (NOI) to prepare an environmental impact statement (EIS) was published in the Federal Register on January 25, 2011. After the NOI was published, six public meetings and workshops were held for the purposes of refining the draft proposed action. Many commenters provided recommendations on locating treatments in order to reduce the potential for losing resources and public infrastructure from fire. An evaluation process was developed to evaluate fire risk and risks to forest health (see appendix D). This document represents how comments were addressed in terms of prioritizing and placing treatments. Another topic of was the

conservation of old and large trees. An old tree strategy, that is integral to the proposed action, is located at appendix B. A large tree implantation strategy, currently under development, is located at appendix C. During the scoping meetings and workshops, we recorded many comments requesting additional detail on vegetation and prescribed fire treatments. Many people asked for detailed narratives and visual examples of what the post-treatment landscape could look like. For this reason, the proposed action includes a section that provides details for most proposed treatments (pp. 43 to pp. 57).

Incorporation of adaptive management into the proposed action

Adaptive management provides an implementation tool that goes beyond the "predict-mitigate-implement" model and incorporates an "implement-monitor-adapt" strategy. Given the scale of this restoration effort, adaptive management will provide flexibility to account for inaccurate initial assumptions, to adapt to changes in environmental conditions or to respond to subsequent monitoring information that indicates that desired conditions are not being met (USDA 2010). Adaptive management allows flexibility in adjusting the type (treatment method), timing (when treatments are implemented), intensity and frequency of treatments – as long as the effects of all options have been analyzed in NEPA.

Most proposed activities include a suite of possible management actions. These actions provide options that would be used to specifically implement a treatment that best responds to the site-specific resource condition. For example, a roadbed proposed for decommission may be revegetating naturally. In this case, removing all the emerging ground cover as a part of decommissioning may not be desirable. A sign, gate or earthen berm that would preclude future disturbance from motorized use may be the best option. By having a variety of management actions that have been analyzed, the forests would be able to select the best method for moving that road segment towards desired conditions.

A comprehensive monitoring and adaptive management plan is under development. This plan will display desired conditions by resource and include management actions that could be implemented if monitoring indicates the original approach is failing to result in the desired outcome within a specified timeframe. This is consistent with Forest Service policy which states,

> "Disclose the site-specific effects of all of these actions, adjustments, or use of acceptable tools in the analysis along with the monitoring methods to be used to determine the effectiveness of each. If monitoring demonstrates that the intended effects are not being achieved through the initial management action, the action can be modified using one or more of the identified adaptive management actions in a way that better achieves the intended effects…So long as monitoring indicates that the environmental effects of each action do not exceed the bounds of those anticipated in the original decision and the actions serve to move the project toward the intended effects, implementation continues using the "implement-monitor-adapt" cycle without the need for new or supplemental NEPA review (FSH 1909.15,14.1)".

Proposed Action

In response to the purpose and need, the Coconino and Kaibab National Forests propose to conduct approximately 595,370 acres of restoration activities (within the 988, 764 acre project area) over approximately 10 years or until objectives are met. Approximately 20,000 to 30,000 acres of vegetation would be treated annually and up to 60,000 acres would be prescribed burned annually across the two forests. Restoration activities would:

- Mechanically cut trees and prescribe burn on approximately 389,993 acres
- Cut trees by hand and prescribe burn on slopes greater than 40 percent on approximately 99 acres
- Prescribe burn only on approximately 205, 278 acres
- Decommission 941 miles of existing system and unauthorized roads on the Coconino NF
- Decommission 170 miles of unauthorized roads on the Kaibab NF
- Construct 46 miles of temporary roads for haul access and decommission when treatments are finished
- Reconstruct 27 miles of existing open roads for natural resource, health and human safety concerns
- Open 183 miles of existing closed roads in order to conduct treatments and decommission (close and rehabilitate) as needed when treatments are finished
- Restore 78 springs
- Restore 43 miles of ephemeral channels
- Construct 82 miles of protective (aspen and springs) fencing

Table 13 displays acres to be thinned and burned by restoration unit (RU). Table 14 displays the acres proposed for all other restoration activities by RU. Tables 15 and 16 display proposed thinning and burning treatments in goshawk and MSO habitats. Figure 24 displays general locations for the proposed vegetation thinning and prescribed fire. Figures 25 and 26 display the general vicinity of road decommission, spring, and ephemeral channel restoration activities.

Pages 43 to 57 provide descriptions of each treatment. A series of treatment maps (appendix A) that provide more detail is available on the 4FRI website: http://fs.usda.gov/4fri and on CD. An old tree implementation strategy that is integral to the proposed action is located at appendix B. A large tree implementation strategy, currently under development, is included in appendix C for comment purposes only. This strategy includes some concepts generated by the 4 FRI stakeholder group and other publics through scoping.

Forest plan amendments are integral to the proposed action. Three non-significant forest plan amendments would be required on the Coconino NF to implement the proposed action. One non-significant forest plan amendment would be required on the Kaibab NF. Additional plan amendments may be needed to achieve the desired condition related to open-ness. See appendix F for detailed information on the proposed amendments.

Table 13. Summary of proposed action mechanical treatment and prescribed fire acres by restoration unit (RU)

Restoration Unit (RU) No.	Acres of Proposed Mechanical and Prescribed Fire Treatments			Total Acres Proposed for Treatment by RU
	Mechanical Treatment with Prescribed Fire	Thin by Hand on Slopes > 40% and prescribe burn	Prescribed Fire Only	
1	123,581	0	32,798	**156,379**
3	113,807	0	35,732	**149,539**
4	110,094	0	57,816	**167,910**
5	11,978	99	65,888	**77,965**
6	30,533	0	13,045	**43,578**
Totals	**389,993**	**99**	**205,278**	**
Mechanical Treatment and Prescribe Fire Project Total (Acres)				**595,370**

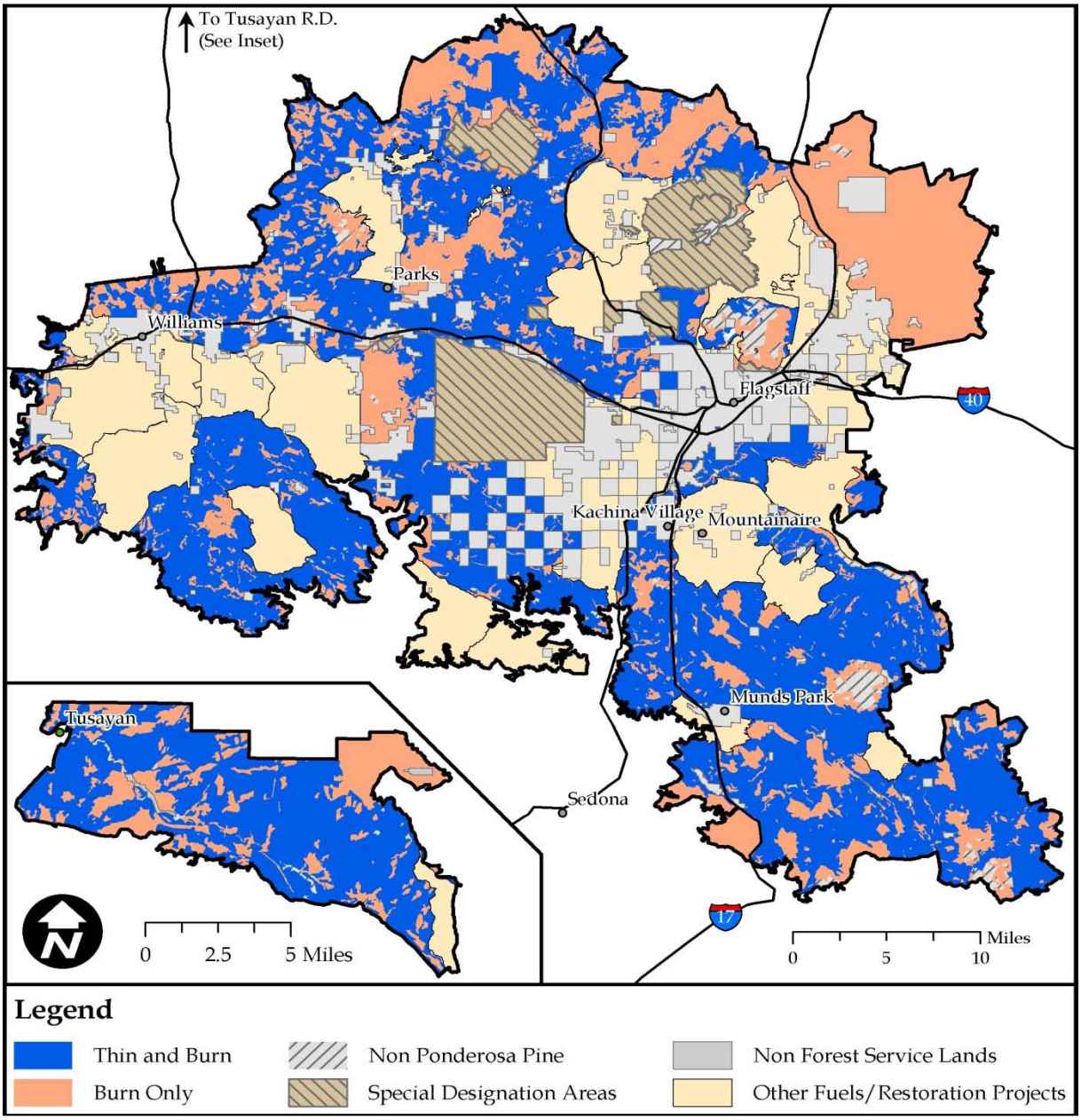

Figure 24. General locations of proposed thinning and prescribed fire treatment areas within the project area

Table 14. Roads, springs, streams and aspen fencing activities by restoration unit (RU)

Restoration Unit No.	Proposed Road Activities (Miles)					Construct Aspen Fencing **(miles)	Restore Riparian Habitat and Ephemeral Streams (miles)	Restore Springs (No.)
	Decommission Closed Roads	Decommission Unauthorized Roads	Construct Temporary Roads*	Open Closed NFS Roads*	Reconstruct NFS Roads			
1	206	0	16	48	7	11	24	32
2	0	0	0	0	0	0	0	0
3	152	109	15	68	9	17	8	28
4	210	36	9	35	5	41	5	14
5	373	0	1	7	2	14	5	4
6	0	25	5	25	5	0	1	0
TOTAL	**941**	**170**	**46**	**183**	**27**	**82**	**43**	**78**

*Temporary roads would be obliterated after project completion. Closed roads opened to provide project access would be returned to closed status after project completion.

**Fencing options include wood fencing and/or felling trees to serve as protective barriers.

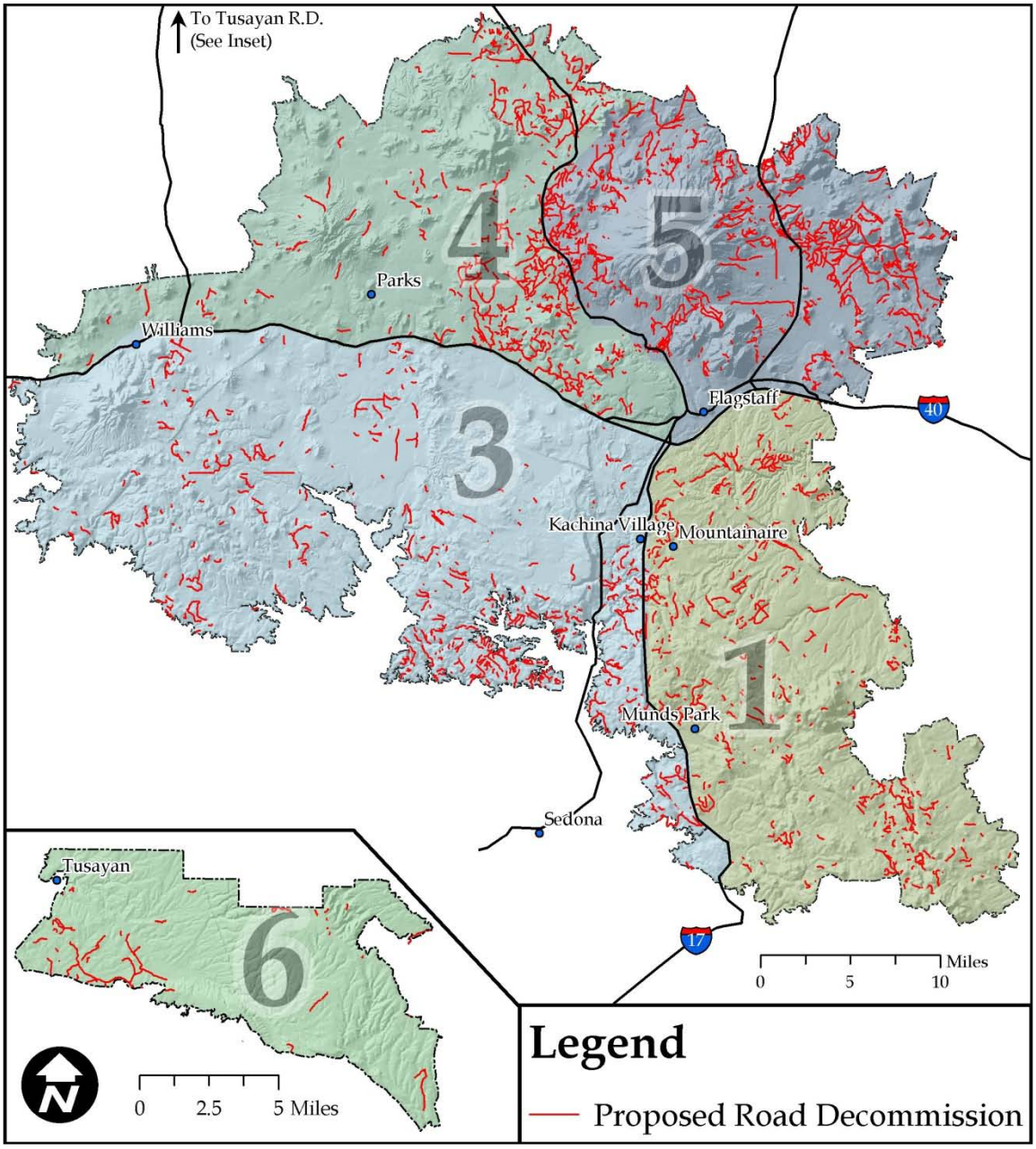

Figure 25. General vicinity of roads proposed to be decommissioned

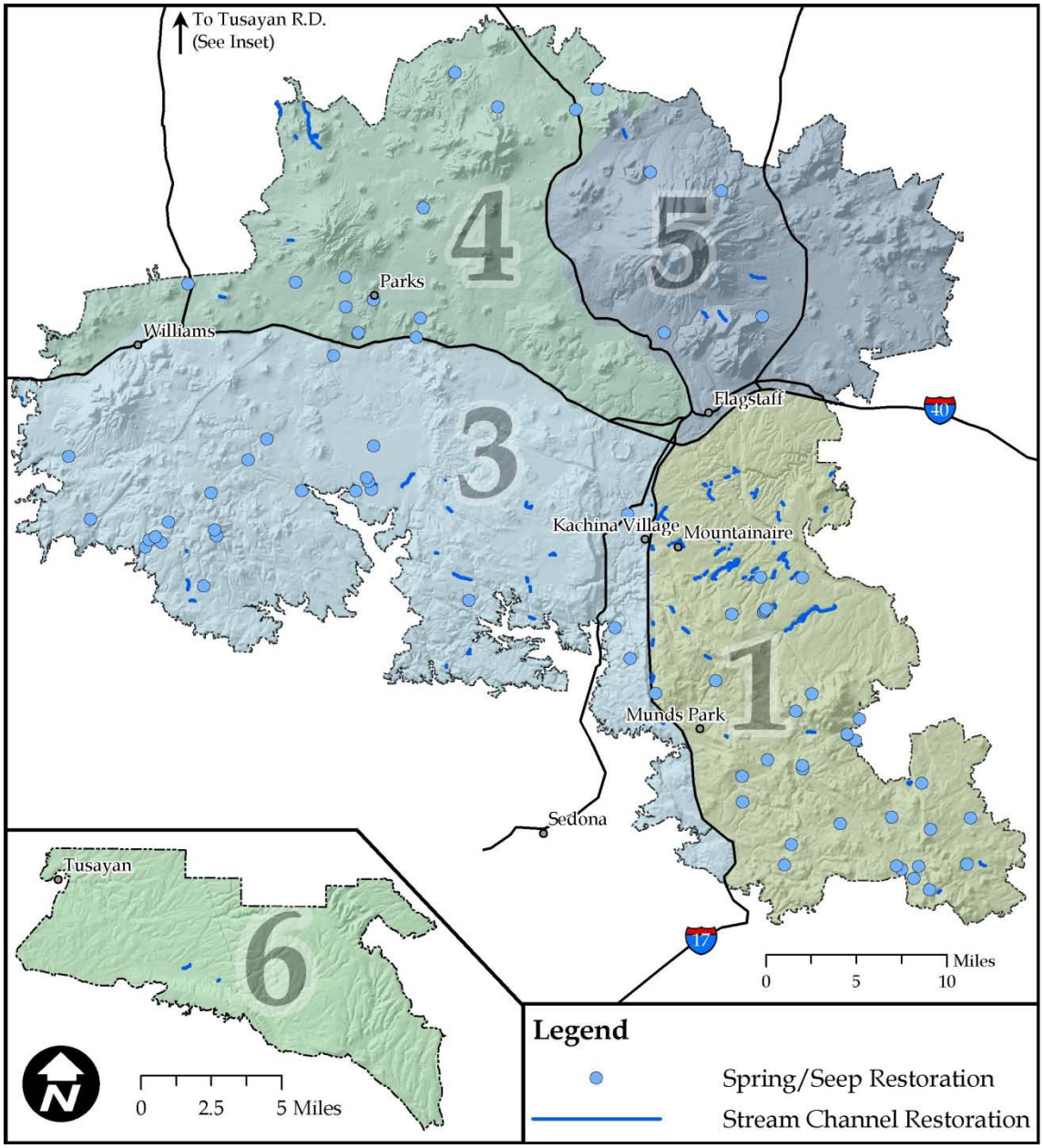

Figure 26. General vicinity of proposed spring and ephemeral channel restoration

Table 15. Proposed Action summary of treatments in goshawk habitat

Vegetation Treatment Type	Acres Proposed for Treatment by goshawk habitat type		
	Foraging	Post-Fledgling Family Area (PFA)	Dispersal Post-Fledgling Family Area (dPFA)
Uneven-aged Thinning (UEA)*	145,786	10,076	4,435
Intermediate Thinning (IT)	53,752	4,298	1,022
Stand Improvement Thinning (SI)	19,954	1,004	76
Savanna Thinning	45,155	0	0
Grassland Thinning	11,217	0	37
Pine-Sage Thinning	4,674	392	196
Total acres by habitat type	**280,538**	**15,770**	**5,766**
Total acres proposed for treatment in goshawk habitat			**302,074**

*UEA includes treatments in the wildland urban interface (WUI). See the "proposed action treatment summaries" section for detailed treatment descriptions.

Table 16. Proposed Action summary of treatments in MSO habitat

Treatment Type*	MSO Habitat Type			
	Protected	Restricted	Target/Threshold	Total Acres
Burn Only	24,225	2,354	301	26,880
MSO Restricted	0	65,224	*	65,224
MSO Target	0	*	6,518	6,518
MSO Threshold	*	*	1,894	1,894
PAC	12,449	*	*	12,449
Total	**36,674**	**67,577**	**8,713**	**112,964**

* See the "proposed action treatment summaries" section for detailed treatment descriptions

Proposed Action Treatment Descriptions

Proposed treatment objectives and summaries are included below. Photos of what could be expected post-treatment have been included (note: higher resolution photos can be found on the 4FRI website: http://fs.usda.gov/4fri. Additional design features and best management practices for vegetation, soils and watershed, botany, wildlife, range, heritage, recreation, and visual resources are under development and will be part of the Draft Environmental Impact Statement (DEIS) document.

Vegetation - Range of Treatment Methods

Uneven-aged Thinning (UEA): The objectives of this type of thinning is to: (1) establish interspaces between residual tree groups and clumps, (2) establish regeneration openings where seedling/sapling size class trees are under-represented, (3) establish interspaces between individual trees and clumps of trees within a group, (4) enhance growing space for younger age classes to become free to grow with limited competition, and, (5) meet Tusayan, Williams, and Flagstaff community wildfire protection plan (CWPP) desired conditions in the wildland urban interface (WUI). Additional forest plan amendments may be needed to achieve the desired condition for open-ness.

The percent of interspaces for this type of treatment would vary by intensity. Intensity is determined by site quality and reference conditions of soil types. Areas with high site quality would have fewer interspaces, while sites with low site quality or on mollic integrade soils would have more interspaces. A low-intensity UEA would have interspaces that range from 10 to 25 percent. A moderate-intensity UEA would have interspaces that range from 25 to 40 percent while a high intensity UEA would have interspaces that range from 40 to 55 percent. Treatments in the wildland urban interface (WUI) would use UEA 55 to 70 percent. Figures 27 through figure 30 portray examples of post-treatment conditions.

Treatment Summary:

- Thin tree groups and establish interspaces adjacent to groups to an average of 50 to 70 square feet of basal area. Actual results would vary depending on current stand conditions.
- Tree groups would range in size from 0.1 to 1 acre and generally consist of four to twenty dominant and co-dominant trees per 1/10 acre.
    - Groups of trees in the mid-age and older VSS classes would have interlocking or nearly interlocking crowns. The desired canopy cover in these groups is 40 percent or greater.
- Crown spacing between groups would average 25 to 80 feet depending on treatment intensity.
- The priority location for interspaces would be in currently non-stocked areas and in areas that lack pre-settlement evidence.
- Regeneration openings up to four acres may be created to recruit a new age class (depending on current VSS structure to move toward or maintain uneven-aged stand conditions). Regeneration openings would average 0.3 to 0.8 acres and would be implemented on 10 to 20 percent of the area. The priority location for regeneration openings would be within moderate to severe dwarf mistletoe infection centers.

Exceptions within northern goshawk PFAs: (1) canopy cover within the mid-age and older tree groups would be maintained at or above 50 percent, (2) tree groups would be thinned and interspaces adjacent to groups would be established to an average of 70 to 80 square feet of basal area, and, (3) crown spacing between groups would average from 25 to 70 feet depending on treatment intensity.

Figure 27. Example of post-treatment UEA low intensity treatment (Mountainaire project, Coconino NF)

Figure 28. Example of post-treatment UEA moderate intensity treatment (Mountainaire project, Coconino NF)

Figure 29. Example of post-treatment UEA high intensity treatment (Mountainaire project, Coconino NF)

Figure 30. Example of post treatment UEA high intensity treatment in the wildland urban interface (WUI) (Mountainaire project, Coconino NF)

Intermediate Thinning (IT) – This type of thinning would be used to: (1) thin stands that are moderately to heavily infected with dwarf mistletoe to improve growth and vigor, (2) retain the best dominant and co-dominant trees with the least amount of mistletoe, and, (3) establish interspaces between residual tree groups and clumps. Improved growth and vigor of the best trees rather than sanitation is a primary objective.

Treatment Summary:

- Thin stands that are moderately-to-heavily infected with dwarf mistletoe to improve growth and vigor.
- Thin tree groups to an average of 70 to 90 square feet of basal area.
- Retain the best growing dominant and co-dominant trees with the least amount of mistletoe.
- Establish interspaces between residual tree groups.
- Establish crown spacing between groups that would average from 25 to 80 feet depending on treatment intensity.
- The priority location for interspaces would be in currently non-stocked areas and in areas that lack pre-settlement evidence (see appendix B for the old tree strategy).

Stand Improvement Thinning (SI) – This type of thinning would be used to: (1) thin and improve the growth and vigor of young, even age plantations or stands dominated by trees <8.5" dbh; (2) begin the conversion to uneven age condition, and (3) establish interspaces between residual tree groups and clumps (figure 31).

Treatment Summary:

- Thin young, even-aged stands dominated by trees <8.5" dbh to improve growth and vigor.
- Thin tree groups to an average stand density index (SDI) of 90 to 115 (20 to 25 percent of max SDI for ponderosa pine).
- Establish interspaces between residual tree groups.
- Establish crown spacing between groups that would average 25 to 80 feet depending on treatment intensity.
- The priority location for interspaces would be in currently non-stocked areas and in areas that lack pre-settlement evidence.

Figure 31. Example of post treatment stand improvement (SI) thinning (Mountainaire project, Coconino NF)

Savanna Thinning - This type of treatment is specific to areas where soils developed under an open tree canopy and a robust herbaceous (grass/forb) understory. Thinning would be used to: (1) focus removal on those trees that have become established post-settlement using pre-settlement tree evidence as guidance, and, (2) attain the desired amount of interspaces between tree groups or individuals that range from 70 to 90 percent (figure 32).

Treatment Summary:

- Restore pre-settlement tree density and pattern. Pre-settlement evidence would be used as a guide to the historic range of variability (see appendix B).

- Remove trees that have become established since the interruption of the historic fire regime in excess of what pre-settlement tree evidence indicates.

- The desired amount of interspaces between tree groups or individuals would range from 70 to 90 percent of the treatment area. Actual results would vary depending on current stand conditions.

Figure 32. Example of post-treatment savanna thinning (Mountainaire project, Coconino NF)

MSO restricted habitat treatments

Treatment Summary:

- Conifers would be thinned to a target 60 to 100 basal area using a combination of small group cuts and/or thinning.
- Irregular tree spacing and various tree group sizes would be utilized to create canopy gaps to move toward or maintain uneven-aged stand conditions. In general, stands that have a southerly aspect would be thinned to 60 to 80 basal area and stands with a northerly aspect would be thinned to 80 to 100 basal area. Actual results may vary depending on current stand conditions. Target crown spacing between groups would range from 25 to 60 feet.
- Tree groups would generally consist of 3 to 50 trees; some may have different age classes within. Groups would be made up of dominant and co-dominant trees with interlocking crowns. Groups are identifiable within the pre-treatment stand matrix by aggregations of relatively similar size class, spatially continuous with interlocking canopy or close to interlocking canopy. Where stand conditions do not allow for the creation of groups, individual trees of under-represented VSS classes would be maintained and all other trees would be removed until the next opportunity to create a group.
- Large trees would be targeted for retention with a goal of ≥20 trees per acre ≥18 inches dbh. No trees 24 inches dbh or larger would be removed. Where moderate to heavy dwarf mistletoe infection centers are located, the focus would be on the removal of infected trees to establish new regeneration groups or to favor existing regeneration. Where regeneration groups would not to be established, the focus would be on reduction of dwarf mistletoe infection within the leave tree groups (the best dominant and co-dominant trees with the least amount of mistletoe would be retained).
- Oak would not be cut and oak >5” drc (diameter root collar) /dbh may be considered as residual trees in the target group spacing. Areas may also be treated with periodic low intensity prescribed burns where and when feasible. Course woody debris, snags, and groups of oaks or aspen would be protected from fire impacts either through burn prescriptions or other techniques.

MSO target/threshold habitat treatments

Treatment Summary:

- Treatments would be designed to maintain existing target/threshold conditions per Table III.B.1 in the MSO Recovery Plan. Treatments would be designed to manage target stands to meet target/threshold conditions. Stands would be managed to sustain target/threshold conditions.
- Treatments would be designed to maintain at least 150 basal area, with a portion of those acres at or above 170 basal area. There is a minimum requirement of 20 trees >18” dbh per acre.
- Treatment of these stands may include thinning trees and/or light prescribed burns may be used to treat fuels and mitigate fuel hazards where feasible.

- Irregular tree spacing would be used to create canopy gaps to move toward or facilitate stand conditions that may be more conducive to low-intensity prescribed fire treatment. Within existing old growth stands, old growth attributes would be retained. Course woody debris, snags, and groups of oaks would be protected from fire impacts either through burn prescriptions or other techniques.

MSO Protected Activity Areas (PACs) treatments

Treatment Summary:

- Ponderosa pine sites designated as MSO PACs are protected habitat with specific requirements for treatment. Each PAC has a 100-acre no treatment area around the known nest site.

- Outside the 100-acre no treatment area, trees may be thinned and/or light prescribed burns may be used to treat fuels and mitigate fuel hazards where feasible. Each PAC to be treated would have an upper diameter limit of trees (less than 16" dbh) that may be thinned. All trees above that limit would be retained.

- Irregular tree spacing would be used to create canopy gaps to move toward or facilitate stand conditions that may be more conducive to low-intensity prescribed fire treatment. Areas may be treated with periodic low intensity prescribed burns where and when feasible. Within existing old growth stands, old growth attributes would be retained. Course woody debris, snags, and groups of oaks would be protected from fire impacts either through burn prescriptions or other techniques.

Meadow Restoration with hand thinning or limited mechanical treatment methods

Treatment Summary:

- Promote and re-establish the historic meadow edge as defined by the current forest structure of young trees encroaching around the meadow edge.

- Large trees with long-lived characteristics would be retained. Trees not meeting long-lived characteristics may be removed using limited mechanical or hand treatment options. Where evidence of large trees exist, it may be desirable to leave replacement trees if they occur. Where oak occur, they would not be cut. Areas may also be treated with periodic low-intensity prescribed burns where and when feasible. Course woody debris, snags, groups of oaks would be protected from fire impacts either through burn prescriptions or other techniques.

Aspen Treatments

Treatment Summary:

- Inclusions of aspen remnants within portions of ponderosa pine stands would be regenerated by removing all post-settlement conifers from within ½ to 1 chain (66 feet) of the aspen clone. Some removal of aspen within the clone as well as ground-disturbing activity or burning may occur to stimulate suckering. Each clone would be evaluated to

determine the need for fencing or creation of other barriers to reduce ungulate browsing of regenerating aspen.

Pine-Sage (Tusayan district, Kaibab NF) Treatments

Treatment Summary:

- Restore pre-settlement tree density and pattern. Remove trees that have become established since interruption of historic fire regime in excess of what pre-settlement tree evidence indicates. All pre-settlement trees would be retained. The largest post-settlement trees that most closely resemble old trees in size and form would be retained as replacement trees adjacent to pre-settlement tree evidence. Actual results may vary depending on current stand conditions. See appendix B, old tree retention strategy.

- In stands where oak occurs, oak would not be cut. Areas may also be treated with periodic low-intensity prescribed burns where and when feasible. Course woody debris, snags, and groups of oaks and openings occupied by sagebrush would be protected from fire impacts either through burn prescriptions or other techniques.

Treatment design for aspen and Gambel oak treatments

- Methods that promote and stimulate the growth of Gambel oak and aspen would be used in order to improve vegetation diversity and wildlife habitat.

- Types of protective fencing around treated aspen includes fencing or using trees that have been felled and placed to serve as barriers from ungulate use during critical growth periods.

Vegetation Treatment Design Features Common to all Treatment Types:

- All thinning would be designed to move stands toward the desired condition as outlined in the Coconino NF and Kaibab NF forest plans of uneven-aged stand conditions, a balance of Vegetation Structural Stages (VSS) classes, and canopy cover within the mid-age and older tree groups at or above 40 percent. Treatments would strive to distribute tree groups according to desired VSS percentages in the forest plans. Groups of under-represented VSS classes would be retained throughout to meet VSS targets. In stands where oak occurs, oak would not be cut. In stands where oak does occur, oak >5” drc /dbh may be considered as residual trees in the target group spacing. Areas may also be treated with broadcast burns where and when feasible.

- Project-created slash may be mechanically treated, removed, lopped and scattered, piled, burned or retained for soil stabilization or other resource benefits. Existing ground fuels may also be treated by relocation or removal to reduce fire hazard if quantities are above forest plan guidelines. Course woody debris would be managed for 5 to 7 tons per acre after treatment. Bark beetle prevention measures would be implemented as necessary. Snags or hazard trees within a distance of twice their height from private land boundaries or along key roads may be felled. In all other areas conifer snags >12” dbh would be retained except in cases of human health and safety concerns.

- Vegetation thinning treatments would focus on reducing the most abundant tree size classes and maintaining the under-represented tree size classes in order to achieve and/or set the project area on the trajectory to attain greater diversity (heterogeneity) in spatial patterns and size class distribution (see Large Tree Implementation Strategy, appendix C).

- Treatments would be designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape.

- Old trees would not be targeted for cutting; however, exceptions may be necessary. Exceptions include removing trees that would pose a greater negative effect to the environment if they were not removed. An example of this would be to cut an old tree in order to accommodate the turning radius of a logging truck, rather than relocating an entire road. Another exception would be removing an old tree to address human health and safety concerns. See appendix B, old tree retention strategy.

- Treatments would be designed to create tree groups and clumps that stimulate grass, forbs and individual tree growth. Treatments would decrease the potential for undesirable fire behavior and effects.

- In stands where oak >5" drc occurs, oak would not be cut.

- Snags, groups of oaks, and course woody debris would be managed to meet forest plan requirements and move towards desired conditions.

Prescribed Fire

Prescribed fire would be used to: (1) minimize the potential for undesirable fire effects and behavior by reducing surface and ladder fuels, (2) to break up vertical and horizontal fuel continuity, (3) restore historic fire regimes, (4) reduce/remove pine encroachment into grasslands and aspen stands, (5) provide a beneficial disturbance to stimulate suckering in aspen stands, and, (6) help improve/restore ecological processes and wildlife habitat across the project area (figure 33).

Range of Treatment Methods

Pile burning – If needed, pile burning, hand piles or machine piles, would be used when conditions are favorable and the risk of fire spread is low. Piles would be located far enough away from residual trees and shrub patches to manage scorch to canopies and trunks. These distances would vary, depending on the size of the piles.

Broadcast burns – Broadcast burns would be accomplished by applying low-to-moderate severity fire using hand, mechanical, or aerial firing methods. In all cases, prescribed fires may be conducted before or after mechanical treatments. Mechanical treatments following broadcast burns would allow sufficient time for surface vegetation to recover to minimize impacts from the mechanical treatments (generally 2 to 3 years). Broadcast burns following mechanical treatments would be conducted after surface fuels have recovered sufficiently to produce fire behavior that can meet objectives. Burn unit size would be maximized when possible to facilitate landscape restoration objectives. Broadcast burns would be repeated as necessary to move the project area towards the desired condition.

Firelines – Firelines would be used to facilitate broadcast burns or pile burning operations as needed. Line construction may consist of mechanically removing herbaceous vegetation, and pruning or cutting woody vegetation. Where necessary, vegetation may be removed down to mineral soil. Individual piles or groups of piles may have fireline cut around them or have surrounding fuels wetted down to minimize creeping if conditions indicate this is desirable. Firelines would be rehabilitated. This may include pulling removed material back into the lines, hand constructing water diversion channels and/or water bars, or laying shrubs or woody debris in the lines following burning. Firelines may also consist of natural barriers, roads and trails.

Design Features Common to all Prescribed Burning Actions

- Prescribed fire (piles, broadcast, and jackpot burning) would occur in accordance with Arizona Department of Environmental Quality requirements. Smoke reduction techniques would be utilized whenever possible to minimize impacts to sensitive receptors downwind from burn unit/s.

- Throughout the life of this project, it is likely that some large and/or old trees may be damaged or killed by prescribed fire. It would not be possible to mitigate every large and/or old tree when up to 60,000 acres of prescribed fire would be implemented annually. However, the damage or mortality to these trees would be minimized by implementing prescription parameters, ignition techniques, raking, wetting, or otherwise mitigating fire impacts to the degree necessary to meet burn objectives.

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Figure 33. Example of thinned and burned ponderosa pine forest (one-year post treatment) east of the community of Tusayan, Arizona

Roads - Range of Treatment Methods

Treatment Summary:

- Temporary and closed roads that are opened for treatment purposes would be used during project implementation. Once treatment has occurred, temporary roads would be decommissioned. Closed roads would be decommissioned as needed and returned to a closed status.
- Reconstruction of open, existing roads may include road blading, culvert installation, culvert replacement and gravelling.
- Decommission methods include options such as installing signs (figure 34), gates, rock barriers, or ripping and re-contouring of slopes and installing drainage features such as waterbars (figure 35 and figure 36). Routes that have established vegetation may need minimal treatment while others may need to be entirely ripped, seeded and slopes re-contoured.
- Road reconstruction in the vicinity of ephemeral, intermittent, and perennial water courses would be designed to lessen the impact on these waters. The desired condition for stream road segments is to have ephemeral, intermittent, and perennial water courses slow the speed of water flow, have access to the flood plain, transport sediment, and maintain longer sustained base flows on the landscape, rather than a flush of peak flows. Floodplains are functioning and lessen the impacts of floods on human safety and health. Road reconstruction may include the construction of rock rip-rap, the installation of new culverts, and the construction of low water crossings.

Figure 34. Use of signs and downed trees as decommission method

Figure 35. Ripping and vegetation (planting) decommission method

Figure 36. Slope ripping and re-contouring decommission method

Ephemeral Streams – Range of Treatment Methods

Restoration treatments may include: (1) re-establishing former drainage patterns, stabilizing slopes, and restoring vegetation, (2) laying back banks to their natural angle and restoring vegetation, (3) constructing site protection from grazing ungulates, (4) removing and rehabilitating stock tanks, (5) restoring vegetation appropriate to site potential, and/or, (6) other methods designed to meet the specific conditions associated. Emphasis would be on non-structural methods over structural methods.

Springs and Seeps – Range of Treatment Methods

- If vegetation/soils are in satisfactory condition, restoration treatments may include: (1) removing tree canopy to pre-settlement condition within 2 to 5 chains (130 feet to 330 feet) of the spring where tree roots are encroaching on mesic soils associated with a seep or spring, and, (2) prescribed burning.

- If vegetation and soils are below potential or are in an impaired/unsatisfactory condition, restoration treatments may include: (1) removal of tree canopy to pre-settlement condition within 2 to 5 (130 feet to 330 feet) chains of the spring, where tree roots are encroaching on mesic soils associated with a seep or spring, (2) removal of noxious weeds, (3) prescribed burning, and (4) providing protection measure for the stressor (cause of the impairment or unsatisfactory condition) such as fencing, jackstrawing or the removal or relocation of the road or trail.

Relationship to the Forest Plans

The Coconino NF and Kaibab NF Land and Resource Management Plans (hereafter referred to as "forest plans") set forth in detail the direction for managing the land and resources of the forests. The desired conditions for the project are based on forest plan objectives, goals, standards, and guidelines. As appropriate, the desired conditions also reflect the language from the draft revised forest plans which are being developed. The analysis will tier to each forest's Final Environmental Impact Statements (USDA 1987) (USDA 1988), as encouraged by 40 CFR 1502.20.

The project area includes 23 Management Areas (MA) as described in the Coconino NF forest plan (pp. 46 to 206-113). Ponderosa pine and mixed conifer on less than 40 percent slopes (MA-03) makes up approximately 194,464 acres of the project area. Lake Mary Watershed (MA 35), West (MA-03), Doney (MA-11) Cinder Hills (MA 13), unproductive timber land (MA 6) and Deadman Wash (MA 32) comprise another108,724 acres in the project area. The remaining 14 management area acres within the project areas range from as few as 15 acres (Developed Recreation Sites MA 15) to approximately 8,968 acres in the Craters MA (MA 31).

On the Kaibab NF, the project area includes seven Geographic Areas (GAs) and one Land Use Zone (LUZ). Williams forestland (GA 2, 10 and 13) makes up approximately 183, 462 acres of the project area. Tusayan forestland (GA 10) makes up approximately 40,997 acres. Western Williams Woodlands (GA 1) accounts for approximately 3,360 acres. The remaining two GAs and one LUZ within the project area range from as few as 4 acres (Upper Basin, GA 9) to 1,518 acres (Tusayan Woodland). Table 17 displays the acreage associated with the predominant MAs and GAs in the project area where the majority of restoration actions are proposed. Chapter 4 of the

forest plans (Coconino NF forest plan, pp. 21 to 206-118), Kaibab NF forest plan (pp. 16 to 114) provides detailed descriptions of forest-wide resource direction specific to the management or geographic areas.

Table 17. Predominant forest plan management areas (MA) and geographic areas (GA) within project area

Management Area (MA) and Geographic Area (GA) within the project area*	Description	Forest-wide MA and GA Acres	Percent (%) of Management Area/Geographic Area in Project Area
Coconino National Forest			
MA 3	Ponderosa pine and mixed conifer on less than 40% slope	511,015	38
MA 6	Unproductive timber lands	67,146	17
MA 35	Lake Mary Watershed	62,536	61
MA 33	Doney	40,530	35
MA 38	West	36,298	53
MA 13	Cinder Hills	13,711	99
Kaibab National Forest			
GA 1	Western Williams Woodland	169, 041	2
GA 2, 10, 13	Williams, Tusayan and Kaibab Plateau Forestland	308,394	59
GA 3	Northern Williams Woodland	65,533	5
GA 9	Upper Basin	43,377	< 1
GA 10	Tusayan Woodland	86,250	2
LUZ 21	Existing Developed Recreation Sites	1,556	70

*Acres and percentages are approximate**.**

Appendix A. Treatment Maps

Figure 37 displays the proposed action treatment maps that are available for review on the 4FRI website at: http://fs.usda.gov/4fri.

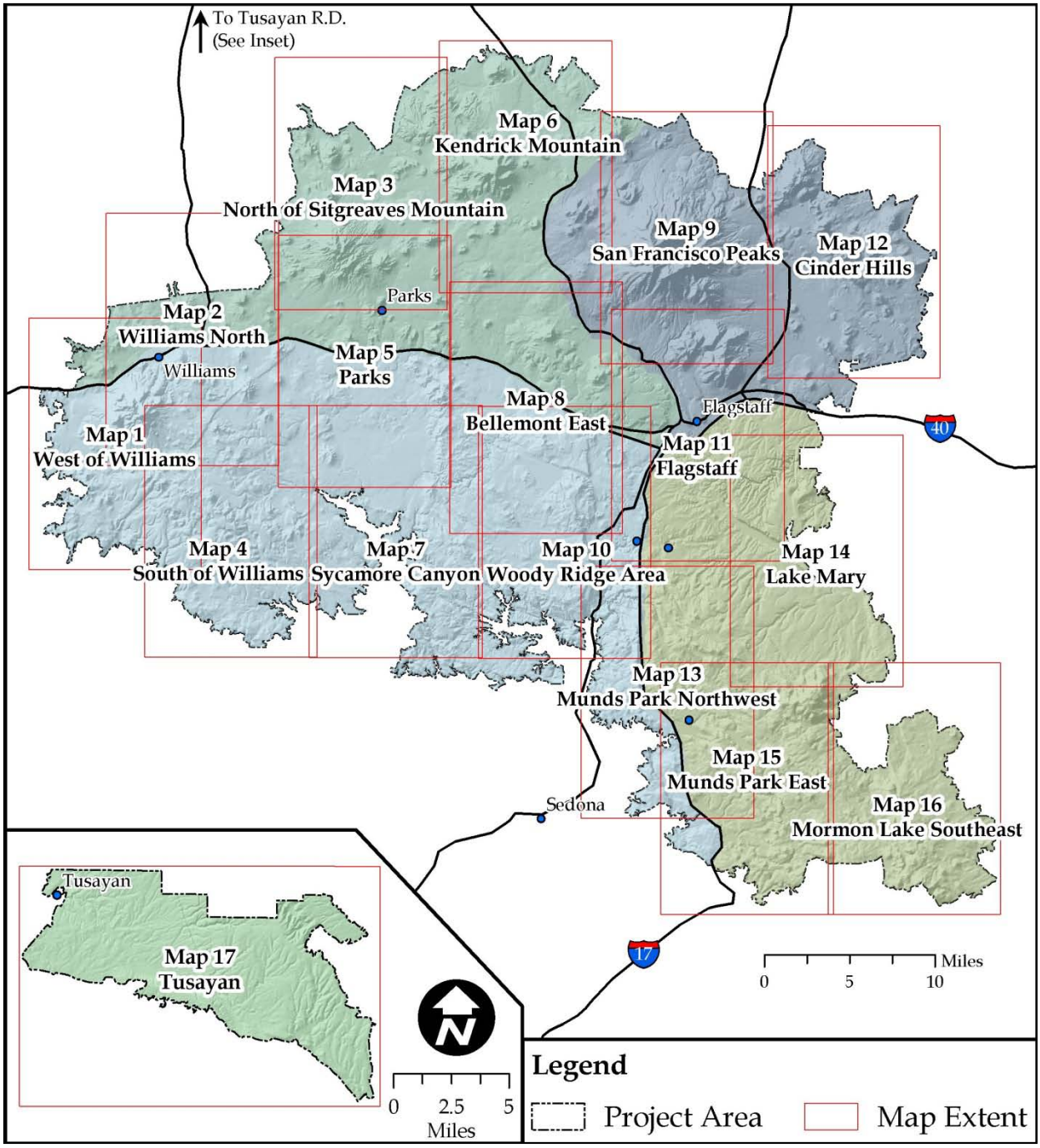

Figure 37. Proposed Action treatment map index

Appendix B. Old Tree Implementation Strategy

Background: Scoping for the Four-Forest Restoration Initiative on the Coconino and Kaibab National Forests has been underway since January of 2011. Several comments have been received recommending that a design feature of the proposed action be no cutting of old growth (pre-settlement trees). The recommendation specifically comes from Wally E. Covington of the Ecological Restoration Institute (ERI), the 4FRI Stakeholders, U.S. Fish and Wildlife Service, Arizona Game and Fish Department, Center for Biological Diversity, Sierra Club and Grand Canyon Trust. The 4FRI Forest Supervisors have decided to implement an Old Tree Implementation Strategy that seeks to clarify the desired conditions for the ponderosa pine ecosystem and how this project would perpetuate old growth in both the short (10-year analysis window) and long term (10 years +).

Project Objective: The objective of the 4FRI Coconino/Kaibab project is a movement towards ecological restoration of ponderosa pine systems. Ecological restoration strives to re-establish and retain ecological resilience.

Desired Conditions: The desired condition for ponderosa pine should be addressed at three scales; landscape, mid and fine:

Landscape Scale:

The forest is composed of trees from structural stages ranging from young to old. Mature and old structural stages are well distributed on the landscape. Forest appearance is variable but generally uneven-aged and open. The forest spatial arrangement is in individual trees, small clumps and groups of trees interspersed within variably-sized opening of grass/forbs/shrubs similar to historic patterns. The size, shape, age, and number of trees per group are variable across the landscape.

The ponderosa pine forest vegetation is composed predominantly of vigorous trees, but declining and old trees are a component and provide for snags, top-killed, lightning and fire-scarred trees, and coarse woody debris, all well-distributed throughout the landscape.

The landscape is a functioning ecosystem that contains all its components, processes, and conditions that result from endemic levels of disturbances and include snags, downed logs, and old trees.

Mid-Scale:

The ponderosa pine forest is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. A mosaic of tree groups generally comprises an uneven-aged forest with all age classes present.

Fine Scale:

Trees typically occur in irregularly-shaped groups and are variably-spaced with some tight clumps that consist of 2 to approximately 40 trees per group. In some cases a single large tree may have the structure necessary to act as a clump.

Scientific Basis for Old Growth:

There are unique characteristics only found in old trees that provide an essential structural feature of old growth forest

Old-growth in frequent-fire ponderosa pine forests are typically uneven-aged at the fine-scale (Meyer 1934, Weaver 1951). They are composed of a mosaic of small (0.1-0.5 ac) old tree groups interspaced with similar sized groups of younger trees, seedlings to mid-aged (Cooper 1961, Morgan et al. 2002, Harrod et al. 1999).

Scientific Basis for Balance of Age Classes:

Some early reports on ponderosa pine age structure demonstrated an approximate balance of age classes at the mid-scale (Woolsey 1911, Pearson 1950); this reference condition of age-balanced forests with a multitude of old growth characteristics was likely self-sustaining at the fine to mid-scales.

Vegetation dynamics, including the establishment, development, senescence (aging), and its composition, structure, and pattern, can be estimated and modeled (see Oliver and Larson 1990, Reynolds et al. 1992, Franklin et al. 2002, Reinhardt and Crookston 2003). Using the reference condition as a baseline, vegetation dynamics of SW ponderosa pine forest was used to approximate the maximum sustainable amount of mature and old vegetation structural stages (VSS). Reynolds et al. (1992) determined this would be achieved with about 20 percent of a landscape in VSS 1 and VSS 2 (grass/ forb, seedlings/saplings), 20 percent in VSS 3 (young forest), 20 percent in VSS 4 (mid-aged forest), 20 percent in VSS 5 (mature forest), and 20 percent in VSS 6 (old forest) These proportions reflect forest development from cohort establishment through canopy closure to old forests. It is unrealistic to expect the desired conditions immediately after treatment. It is important to note that movement towards balanced age class distribution is something that will, in most cases, take decades to achieve. As a comparison the estimated VSS distribution for the 4FRI Coconino/Kaibab project is 4 percent VSS 1 and 2, 37 percent VSS 3, 43 percent VSS 4, 9 percent VSS 5, and 7 percent VSS 6.

Strategy and Intent: Through the implementation of the 4FRI Coconino/Kaibab project resource specialists would strive to retain old pre-settlement trees. Recruitment and retention of old trees would, in the long term, would help to restore a balanced age class distribution at multiple scales and would help to restore the variability of structure and patter of the ponderosa pine system within the project area. Treatments would focus on the reduction of the most abundant age classes and conservation of the under-represented age classes in order to restore a balance of age classes. This would not preclude the removal of trees larger or those smaller than the most abundant size classes in order to meet restoration, resource protection, or health and human safety objectives. Each age class is important and the end result of having abundant old trees is dependent on providing conditions that allow younger trees to grow into older trees.

Movement towards a restored condition would provide greater opportunity for resource managers to restore natural fire patterns and frequency over time. Restored landscapes or those that are closer to achieving the desired condition would result in fewer uncharacteristic wildfire events, higher quality wildlife habitat, and improved hydrologic function across the landscape.

How the Project Would Meet an Objective of Recruiting and Retaining Old Trees: The temporal aspect of moving towards desired conditions is important. Most restoration objectives won't be met immediately post-treatment. The treatments proposed for the project would move the area, in the long term, towards a restored condition that more closely represents the natural range of variability with respect to the structure, pattern, and composition of the ponderosa pine system within the project area. Restoration would be a stepwise process, which in most cases would require multiple entries and decades before the desired condition is achieved.

The preceding discussion describes the importance and function of old trees in the ponderosa pine ecosystem. Old trees (approximately $\geq$ 150 years old) would be retained regardless of their diameter within the Four-Forest Restoration Initiative on the Coconino & Kaibab EIS area. Removal of old trees would be rare. Exceptions would be made for threats to human health and safety and those rare circumstances where the removal of an old tree is necessary in order to prevent additional habitat degradation.

Appendix C. Large Tree Implementation Strategy (Not Part of the Proposed Action, included for public comment only)

Introduction

As identified in the purpose and need (page 8) there is a major need to move vegetation structure and diversity from the current situation towards a forest that is more resilient and sustainable in the face of uncharacteristic fire and climate change. Currently, the tree canopy density for ponderosa pine is 75 percent in moderately closed to closed classifications (page 9) and over 50 percent of the project area lacks age and size class diversity and is in an even-aged structure. To address these conditions the proposed action (pp. 36-37) calls for nearly 390,000 acres of mechanical treatment with prescribed fire and another 205,000 acres of prescribed fire only. These treatments may result in the taking of large post-settlement trees (generally those greater than 16 inches in diameter).

There are also specific situations where large diameter trees may need to be removed to meet other ecological or management objectives. For example, treatments for savannas (page 48), MSO habitat and PACs (pages 50-51), meadow restoration (page 51) aspen (pp. 51-52), pine-sage (page 52), Gambel oak (page 52) and seeps and springs (page 57) and mistletoe treatments across many areas (page 21) may all require large trees to be removed to meet ecological or management objectives.

During scoping the removal of any large trees was raised as a concern. This is due to their importance for old growth as described in appendix B but also to their contribution to VSS 5 and 6 which may be under represented across the landscape (pages 14-16). The determination of when to remove large trees is based on site specific conditions best known during the implementation phase of the project. The 4FRI project recognizes that an implementation strategy will need to be part of the final decision to address this issue but is not ripe for inclusion as part of the proposed action. A strategy needs to provide disclosure to the public and guidance to Forest Service resource specialists who will be implementing ecological restoration treatments as described for the desired conditions of the 4FRI Coconino Kaibab EIS. The implementation strategy will not be used as a mechanism for tracking every tree to be cut during project implementation and it will not be considered a new decision or require additional public involvement.

The strategy will be developed as the DEIS is prepared and will be finalized with the FEIS and ROD. At this point we are asking for comments on what needs to be in an implementation strategy. The remaining part of the appendix includes some thoughts generated by the 4FRI stakeholders group based on their concepts about large tree retention. This is a summarized version of the latest stakeholder strategy showing the major areas of agreement they have reached in terms of management issues, ecological objectives and the management approaches that might be used. It is not all inclusive of every potential circumstance a large tree may need to be cut or every possible management approach. It is included to help generate comments.

Stakeholder Large Tree Implementation

This document outlines management issues, ecological objectives and management approaches for those instances where large post-settlement trees will be cut in order to meet restoration objectives. Management approaches have been developed for (1) seeps and springs, (2) riparian, (3) wet meadows, (4) encroached grasslands, (5) aspen forest and woodland, (6) ponderosa pine/Gambel oak forest (pine-oak), (7) within-stand openings, and, (8) heavily stocked stands with high basal area generated by a preponderance of large, young trees.

This strategy may not include every instance where large post-settlement trees will be cut. We recognize there may be additional areas and/or circumstances where large post-settlement trees need to be removed in order to achieve restoration objectives. This strategy does not constrain cutting trees less than 16" dbh, nor does it imply a diameter limitation/cap. The guidance offered here is intended to provide clarification of some situations where large post-settlement trees will be cut in order to meet the desired conditions and outcomes for the project. For the purpose of this document, large post-settlement trees are those that are 16" diameter breast height (DBH) or larger. Trees $\geq$ 18" DBH represent vegetative structural stages (VSS) 5 and 6. VSS 5 and 6 represent the largest and (sometimes) oldest trees. These size classes best corresponds with the successional stage classification system that was developed specific to the forest dynamics of southwestern ponderosa pine.

The 4FRI Coconino Kaibab EIS does not propose to cut old pre-settlement trees, except under rare circumstances as described in Appendix B.

VSS 5 and VSS 6 trees are under-represented across the project area which is nearly one million acres in size. Large post-settlement trees would not be targeted for removal unless there is an ecological need. The purpose of this document is to provide sufficient specificity to translate those ecological needs into implementation guidance.

Seeps and springs

Seeps are locations where surface-emergent groundwater causes ephemeral or perennial moist soil or bedrock. Standing or running water is infrequent or absent. Vegetation and other biological diversity are adapted to mesic soils.

Springs are small areas where surface-emergent groundwater causes ephemeral or perennial standing or running water and wet or moist soils. Vegetation and other biological diversity are adapted to mesic soils or aquatic environments (Feth and Hem 1963).

Management Issue

Seeps and springs exhibit unique, often isolated biophysical conditions that can sustain unique, mesic-adapted biological diversity and can facilitate endemism and speciation. Springs also provide water and other habitat to terrestrial wildlife. Due to the absence of frequent fires in the presence of livestock grazing, the establishment of large post-settlement trees may reduce available soil moisture (Simonin et al. 2007) and block the sunlight necessary to support the unique biophysical conditions associated with seeps and springs.

Removal of trees that have encroached upon seeps and springs may constitute a relatively small part of an overall seep and spring restoration effort, when compared to fully addressing root

causes of overall degradation. Thinning alone, without addressing other sources of degradation, is unlikely to fully restore seeps and springs (Thompson et al. 2002). However, it is a necessary step leading to the restoration of these ecologically important areas.

Ecological Objectives

Conserve and restore the biophysical conditions in seeps and springs upon which terrestrial, mesic-adapted, and aquatic native biological diversity depend.

Management Approach

Large (>16”dbh) post-settlement ponderosa pine trees may be removed to conserve the unique biophysical attributes of seeps and springs according to the following criteria:

- Where large trees are encroaching on mesic soils associated with a seep or spring,
- Where the trees’ drip lines are overlapping or nearly overlapping over a seep or spring to a degree that tree shading is compromising the integrity of a spring’s unique biophysical attributes,
- Where removing the trees does not conflict with existing recovery and/or conservation plan objectives for managing sensitive, threatened or endangered species or their habitat, and,
- Where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past. In these circumstances, an equivalent number of large replacement trees would be left.

Riparian

Riparian areas occur along ephemeral or perennial streams or are located down-gradient of seeps or springs. These areas exhibit riparian vegetation, mesic soils, and/or aquatic environments.

Management Issue

Riparian areas exhibit unique biophysical conditions that can sustain unique, mesic-adapted, or aquatic biological diversity. Riparian areas and the streams, springs, and seeps connected to them often harbor imperiled species that can be sources of endemism. Riparian areas also provide water and other habitat to terrestrial wildlife. In the absence of frequent fires and in the presence of other competing factors, large post-settlement trees may have become established and grown within riparian areas to the point that they compromise available soil moisture or light that support the unique biophysical conditions that are associated with the riparian areas. However, it is likely to be a very rare circumstance that conifer trees of any size would need to be removed from forested riparian zones.

Should trees need to be cut, soil and water best management practices (BMPs) would be implemented. These practices would minimize the impacts of cutting any trees within riparian areas. Removal of trees may constitute a relatively small part of an overall riparian area restoration effort, when compared to addressing the fundamental causes of overall degradation. Thinning alone, without addressing other sources of degradation, is unlikely to fully restore riparian areas.

Ecological Objectives

Conserve and restore the biophysical conditions in riparian habitat upon which terrestrial and aquatic native biological diversity depend.

Management Approach

Large (>16”dbh) post-settlement ponderosa pine trees may be removed to conserve the unique biophysical attributes of riparian areas according to the following criteria:

- Where large trees are growing (rooted) within a riparian area and compromising available soil moisture or light that support that area’s unique biophysical conditions,
- Where removing the trees does not conflict with existing recovery and/or conservation plan objectives for managing sensitive, threatened or endangered species or their habitat,
- Where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular riparian area in the past. In these circumstances, an equivalent number of large replacement trees would be left, and,
- Whenever possible, large trees that have been identified for cutting should be left on-site as snags or logs.

Wet Meadows

High-elevation streamside or spring-fed meadows occur in numerous locations throughout the Southwest. However, less than 1 percent of the landscape in the region is characterized as wetland (Dahl 1990), and wet meadows are just one of several wetland types that occur. Patton and Judd (1970) reported that approximately 17,700 hectares of wet meadows occur on national forests in Arizona and New Mexico.

Wet meadows may be referred to as riparian meadows, montane (or high-elevation) riparian meadows, sedge meadows, or simply as wet meadows. Wet meadows are usually located in valleys or swales, but may occasionally be found in isolated depressions, such as along the fringes of ponds and lakes with no outlets. Where wet meadows have not been excessively altered, sedges (*Carex* spp.), rushes (*Juncus* spp.), and spikerush (*Eleocharis* spp.) are common species (Patton and Judd 1970; Hendrickson and Minckley 1984; Muldavin et al. 2000). Willow (Salix) and alder (Alnus) species often occur in or adjacent to these meadows (Long 2000, 2002; Maschinski 2001; Medina and Steed 2002). High-elevation wet meadows frequently occur along a gradient that includes aquatic vegetation at the lower end and mesic meadows, dry meadows, and ponderosa pine or mixed conifer forest at the upper end. These vegetation gradients are closely associated with differences in flooding, depth to water table, and soil characteristics (Judd 1972; Castelli et al. 2000; Dwire et al. 2006). While relatively rare, wet meadows are believed to be of disproportionate value because of their use by wildlife and the range of other ecosystem services they provide. Wet meadows perform many of the same ecosystem functions associated with other wetland types, such as water quality improvement, reduction of flood peaks, and carbon sequestration.

Management Issue

Wet meadows are one of the most heavily altered ecosystems. They have been used extensively for grazing livestock, have become the site of many small dams and stock tanks, have had roads built through them, and have experienced other types of hydrologic alterations. Most notably, the lowering of their water tables due to stream down-cutting, surface water diversions, or groundwater withdrawal (Neary and Medina 1996; Gage and Cooper 2008) has occurred. In the presence of livestock grazing and hydrologic changes, large post-settlement trees may have established and grown within wet meadows such that they compromise available soil moisture or light creating unique biophysical conditions.

Removal of large trees may constitute a relatively small part of an overall wet meadow restoration effort, when compared to addressing root causes of overall degradation. Thinning alone, without addressing other sources of degradation, is unlikely to restore wet meadows.

Ecological Objectives

Conserve and restore the biophysical conditions of wet meadows upon which terrestrial native biological diversity depend.

Management Approach

Large (>16”dbh) post-settlement ponderosa pine trees may be removed to conserve the unique biophysical attributes of riparian areas according to the following criteria:

- Where large trees are growing (rooted) in a wet meadow,
- Where removing the trees does not conflict with existing recovery and/or conservation plan objectives for managing sensitive, threatened or endangered species or their habitat, and/or,
- Where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular wet meadow in the past. In these circumstances, an equivalent number of large replacement trees would be left.

Encroached Grasslands

Encroached grasslands are herbaceous ecosystems that have infrequent-to-no evidence of pine trees growing prior to settlement. The two prevalent grassland categories in the 4FRI landscape are montane (includes subalpine) grasslands and Colorado Plateau (a subset of Great Basin) grasslands, with montane grasslands being most common (Finch 2004). A key indicator of grasslands is the presence of mollisol soils. Mollisol soils are typically deeper with higher rates of accumulation and decomposition of soil organic matter relative to soils in the surrounding landscape. Grasslands in this region evolved during the Miocene and Pliocene periods, and the dark, rich soils observed in grasslands today have taken more than 3 million years to produce. In addition to their association with mollic soils, grasslands in this region are maintained by a combination of climate, fire, wind desiccation, and to a lesser extent by animal herbivory (Finch 2004).

Typical montane grasslands in this region are characterized by Arizona fescue (*Festuca arizonica*) meadows on elevated plains of basaltic and sandstone residual soils. Montane grasslands are the most naturally fragmented grasslands in the region, ranging from thousands of acres in size (e.g.,

in the White Mountains (Baker 1983)) down to only a few acres. They generally occur in small (<100 acres) to medium-sized (100 to 1000 acres) patches. Historic maintenance of the herbaceous condition in these grasslands is subject to some debate though appears to be primarily driven by periodic fire. The cool-season growth of Arizona fescue also plays a large role in maintenance of parks and openings by directly competing with ponderosa pine seedlings.

Identification of grasslands in this region should use a combination of the Terrestrial Ecosystem Survey, Southwest Regional GAP Analysis, Brown and Lowe Vegetation Classification (Brown and Lowe 1982; TNC GIS Layer 2006) among other existing vegetation and soils data.

Management Issue

Prior to European settlement, pine trees were rarely established in grasslands because they were either outcompeted by production of cool-season grasses or killed by frequent fire (Finch 2004). In the late 1800s, unsustainable livestock grazing practices significantly reduced herbaceous cover, reducing competition pressure on pine seedlings. Coupled with the onset of fire suppression in the early 1900s, pine trees rapidly encroached and recruited into native grasslands (e.g., Allen 1984; Moore and Huffman 2004; Coop and Givnish 2007). Pine encroachment into grasslands has contributed to a significant loss of biodiversity (Stacey 1995) and wildlife habitat particularly for grassland-dependent species such as pronghorn. Plant diversity is particularly important in grassland ecosystems. Grassland plots with greater species diversity have been found to be more resistant to drought and to recover more quickly than less diverse plots (Tilman and Downing 1994). This resilience will become even more important in a warming climate. Pine tree removal, restoration of fire, and complementary reductions in livestock grazing pressure are all necessary to restore structure and function of native grasslands.

Ecological Objectives

Enhance, maintain, and restore naturally functioning grasslands by removing conifer encroachment. Allow for the restoration natural fire regime.

Management Approach

Large (>16”dbh) post-settlement ponderosa pine trees may be removed to conserve the unique biophysical attributes of riparian areas according to the following criteria:

- Where existing grasslands are being encroached and large trees are interfering with overall restoration objectives,
- Where removing the trees does not conflict with existing recovery and/or conservation plan objectives for managing sensitive, threatened or endangered species or their habitat, and/or,
- Where there is evidence that pre-settlement trees have grown in similar patterns in the past, an equivalent number of large replacement trees would be left.

Aspen Forest and Woodland

Quaking aspen (*Populus tremuloides*) occurs in small patches throughout the 4FRI project area. Bartos (2001) refers to three broad categories of aspen: (1) stable and regenerating (stable), (2) converting to conifers (seral), and (3) decadent and deteriorating. Almost all of the aspen

occurring within ponderosa pine forests of the 4FRI project area is seral aspen, which regenerates after disturbance through root sprouting and rarely from seed production (Quinn and Wu 2001). Favorable soil and moisture conditions maintain stable aspen over time. Aspen stands have been mapped across the entire 4FRI area and map layers are available from existing databases.

Management Issue

Aspen occurs within ponderosa pine forests. It is ecologically important due to the high concentration of biodiversity that depends on aspen for habitat (Tew 1970; DeByle 1985; Finch and Reynolds 1987; Griffis-Kyle and Beier 2003). In addition, stable aspen stands serve as an indicator of ecological integrity (Di Orio and others 2005). Aspen is currently declining at an alarming rate (Fairweather and others 2008).

The loss of fire as a natural disturbance regime in southwestern ponderosa pine forests since European settlement has caused much of the aspen-dominated lands to succeed to conifers (Bartos 2001). Other factors contributing to gradual aspen decline over the past 140 years include reduced regeneration from browsing ungulates (Pearson 1914; Larson 1959; Martin 1965; Jones 1975; Shepperd and Fairweather 1994; Martin 2007). More recently, aerial and ground surveys indicate more rapid decline of aspen, with very high mortality occurring in low and mid elevation aspen sites. Major factors thought to be causing this rapid decline of aspen include frost events, severe drought, and a host of insects and pathogens (Fairweather and others 2008) that have served as the “final straws” for already compromised stands.

Removal of encroaching pine trees constitutes part of an overall aspen restoration effort. Thinning alone, without addressing other sources of degradation, is unlikely to successfully restore aspen forests.

Ecological Objectives

Conserve and restore aspen forests and woodlands within the 4FRI project area by restoring appropriate fire regimes and decreasing competition from ponderosa pine. Protect regeneration, saplings, and juvenile trees from browsing.

Management Approach

Large (>16”dbh) post-settlement ponderosa pine trees may be removed in conifer-encroached aspen according to the following criteria:

- Where current post-settlement ponderosa pine tree numbers exceed residual targets that have been identified using pre-settlement conifer tree evidences,
- Where removing the trees does not conflict with existing recovery and/or conservation plan objectives for managing sensitive, threatened or endangered species or their habitat,
- Where fire alone cannot be used to safely and effectively regenerate or maintain aspen, and/or,
- Where site visitation and/or data collection and analysis indicates the need for encroachment mitigation.

Ponderosa Pine/Gambel Oak Forest (Pine-Oak)

A number of habitat types exist in the southwestern United States that could be described as pine-oak. Ponderosa pine forests are interspersed with Gambel oak trees in locations throughout the 4FRI area in a habitat association referred to as PIPO/QUGA (USFS 1997; USDI 1995). Specifically, any stand within the Pinus ponderosa series where ≥10 percent of stand basal area consists of Gambel oak (*Quercus gambelii*) ≥13 cm (5 in) diameter at root collar (drc) is considered to be pine-oak within the 4FRI project area (USDI 1995).

In southwestern ponderosa pine forests, Gambel oak has several growth forms distinguished by stem sizes and the density and spacing of stems within clumps. These include shrubby thickets of small stems, clumps of intermediate-sized stems, and large, mature trees that are influenced by age, disturbance history, and site conditions (Brown 1958; Kruse 1992; Rosenstock 1998; Abella and Springer 2008; Abella 2008a). Different growth forms provide important habitat for a large number and variety of wildlife species (Neff and others 1979; Kruse 1992).

Gambel oak provides high quality wildlife habitat in its various growth forms; and, it is a desirable component of ponderosa pine forests (Neff and others 1979; Kruse 1992; Bernardos et al. 2004). Gambel oak enhances soils (Klemmedson 1987), wildlife habitat (Kruse 1992, Rosenstock 1998; USDI 1995; Bernardos et al. 2004), and understory community composition (Abella and Springer 2008). Large oak trees are particularly valuable since they typically provide more natural cavities and pockets of decay that allow excavation and use by cavity nesters than conifers. In addition to its important ecological role, Gambel oak has high value to humans as it is a popular fuelwood that possesses superior heat-producing qualities compared to other tree species (Wagstaff 1984).

Management Issue

Although management on public lands with regard to oak has changed to better protect the species, illegal fuelwood cutting of Gambel oak and elk and livestock grazing negatively impact oak growth and regeneration (Harper et al. 1985; Clary and Tiedemann 1992; Rick Miller, 1993, unpublished report). Illegal fuelwood cutting of Gambel oak continues to result in the removal of rare, large diameter oak trees (Bernardos et al. 2004).

A literature review by Abella and Fule (2008) found that Gambel oak densities appear to have increased in many areas with fire exclusion, especially in the small and medium-diameter stems (<8” dbh). Chambers (2002) found that Gambel oak on the Kaibab and Coconino National Forests was distributed in an uneven-aged distribution, dominated by smaller size classes (<5 cm dbh) and few large diameter oak trees. Because of Gambel oak’s slow growth rate, there may be little opportunity for these small Gambel oak trees to attain large diameters (>85 cm) (Chambers 2002).

Pine competition with oak has been identified as an issue in slowing oak growth, particularly for older oaks (Onkonburi 1999). Onkonburi (1999) also found that for northern Arizona forests, pine thinning increased oak incremental growth more than oak thinning and prescribed fire. Fule (2005) found that oak diameter growth tended to be greater in areas where pine was thinned relative to burn only treatments and controls. Thinning of competing pine trees may promote large oaks with vigorous crowns and enhanced acorn production (Abella 2008b), and may increase oak seedling establishment (Ffolliott and Gottfried 1991).

Ecological Objectives

(1) Maintain and restore all growth forms of Gambel oak, focusing on enhancing and maintaining larger, older oak trees,

(2) Restore frequent, low intensity surface fire to ponderosa pine-Gambel oak forests,

(3) Restore and maintain brushy thicket, pole and dispersed clump growth forms of Gambel oak by allowing natural self-thinning, thinning dense clumps, and/or burning, and,

(4) Protect Gambel oak growth forms from, damage during restoration treatments including thinning and post thinning slash burning.

Management Approach

In pine-oak, which occurs when ≥10 percent of the stand basal area consists of Gambel oak >13 cm (5 in) diameter at root collar, large (>16 dbh) post-settlement ponderosa pine trees may be removed to conserve oaks according to the following criteria:

In MSO restricted habitat:

- Within MSO habitat and designated critical habitat, the recovery plan for the Mexican spotted owl should be followed to improve key habitat components and primary biological factors, which includes Gambel oak.

Outside MSO restricted habitat:

- Where large post-settlement trees' drip lines or roots overlap with those of Gambel oak trees exhibiting drc of >12", and/or,
- Where removing the trees does not conflict with existing recovery/conservation plan objectives for managing sensitive, threatened or endangered species or their habitat.

Within-Stand Openings

Within-stand openings are small openings (generally 0.05 to 1.0 acres) that were occupied by grasses and wildflowers before settlement (Pearson 1942; White 1985; Covington and Sackett 1992; Sanchez-Meador et al. 2009). Pre-settlement openings can be identified by the lack of stumps, stump holes, and other evidence of pre-settlement tree occupancy (Covington et al. 1997). These openings are most pronounced on sites with heavy textured (e.g., silt-clay loam) soils (Covington and Moore 1994). Current openings include fine scaled canopy gaps. It is not necessary to have the desired within-stand openings and groups be located in the same location that they were in before settlement (the site fidelity assumption). Trees might be retained in areas that were openings before settlement, and openings might be established in areas which had previously supported pre-settlement trees. The within-stand opening management approach described below is distinct from, and should not be, considered as guidance relating to regeneration openings.

Management Issue

Within-stand openings appear to have been self-perpetuating before over-grazing and fire exclusion (Pearson 1942; Sanchez-Meador et al. 2009). Fully occupied by the roots of grasses and wildflowers as well as those of neighboring groups of trees, these openings had low water and nutrient availability because of intense root competition (Kaye et al. 1999). Heavy surface fuel loads insured that tree seedlings were killed by frequent surface fires, reinforcing the competitive exclusion of tree seedlings (Fulé et al. 1997).

These natural openings appear to have been very important for some species of butterflies, birds, and mammals (Waltz and Covington 2004). Often the largest post-settlement trees, typically a single tree, became established in these natural within a stand opening as soon as herbaceous vegetation was removed by overgrazing (Sanchez-Meador et al. 2009). Contemporary within-stand openings or areas dominated by smaller post-settlement trees should be the starting point for restoring more natural within-stand heterogeneity.

Ecological Objectives

(1) Conserve and restore pattern of openings within stands to provide natural spatial heterogeneity for biological diversity,

(2) Break up fuel continuity to reduce the probability of torching and crowning. Restore natural heterogeneity within stands, and ,

(3) Promote snow-pack accumulation and retention to benefit groundwater recharge and watershed processes at small scale.

Management Approach

Large (>16” dbh) post-settlement ponderosa pine trees may be removed to restore the unique biophysical attributes of within stand openings according to the following criteria:

(1) When the presence of such trees would prevent the re-establishment of sufficient within stand openings to emulate natural vegetation patterns based on current stand conditions, pre-settlement evidences, desired future conditions, or other restoration objectives,

(2) Where removing the trees does not conflict with existing recovery/conservation plan objectives for managing sensitive, threatened or endangered species or their habitat, and/or,

(3) Where desired openings are tentatively identified as $\geq$0.05 acre (these openings should be established wherever possible by enlarging current within-stand openings or where small diameter trees are predominant).

Note: It is not necessary to have within-stand openings and groups located in the same location that they were pre-settlement. That is, trees might be retained in areas that were openings before settlement, and openings might be established in areas that had previously supported pre-settlement trees.

Heavily-Stocked Stands (with High Basal Area) Generated By a Preponderance of Large, Young Trees

In some areas, the increase in post-settlement trees has been so rapid that current stand structure is characterized by high density and high basal area of large, young ponderosa pine trees. These stands or groups of stands exhibit continuous canopy which promotes unnaturally severe fire effects under severe fire weather conditions. At the small scale, the management approach would apply on a case-by-case basis. For example, the cutting of large trees may be necessary to meet site-specific ecological objectives in order to reduce the potential for crown fire to spread into communities or important habitats that include Mexican spotted owls and/or goshawk nest stands. This approach would apply when other options would not alleviate severe fire effects.

Management Issue

In stands where pre-settlement evidences, restoration objectives, community protection, or other ecological restoration objectives indicate much lower tree density and basal area would be desirable, large post-settlement pines may need to be removed to achieve post-treatment conditions consistent with a desired restoration trajectory. In stands where evidences indicates higher tree density and basal area would have occurred pre-settlement, only a few large pines may need to be removed. Many of these areas would support crown fire, and thus require structural modification to reduce crown fire potential and restore understory vegetation that supports surface fire.

Ecological Objectives

(1) Natural heterogeneity of forest, savanna and grasslands occurs at the landscape scale,

(2) Natural heterogeneity exists within stands,

(3) Canopy fuel discontinuity reduces the probability of torching and crowning and restores herbaceous fuel continuity to carry surface fire,

(4) Natural fire is desired as the principle regulator of forest structure over time, and,

(5) Groups are restored by retaining the largest trees on the landscape to re-establish old growth structure in the shortest timeframe possible. This applies where appropriate to site conditions, restoration, and species conservation objectives.

Management Approach

Large (>16” dbh) post-settlement ponderosa pine trees may be removed to meet restoration objectives according to the following criteria:

(1) When the presence of trees in this category contributes to a continuous canopy which could result in unnaturally severe mid- or larger-scale (100+ acre) fire effects under severe fire weather conditions,

(2) When removing the trees does not conflict with existing recovery / conservation plan objectives for managing sensitive, threatened or endangered species or their habitat,

(3) When the cutting of such trees is necessary to meet site-specific ecological objectives such as reducing potential for crown fire spread into communities or important habitats such as for Mexican spotted owls and/or goshawk nest stands, and/or,

(4) When other exception categories, if implemented, would not alleviate severe fire effects.

It is not necessary to have within-stand openings and groups located in the same location that they were pre-settlement. That is, trees might be retained in areas that were openings before settlement, and openings might be established in areas that had

.

Appendix D. Mechanical Treatment and Fire Prioritization Process

Mechanical Treatment Classification Process

The mechanical treatment classification process draws on many of the ideas proposed in the 4FRI Stakeholders Landscape Strategy. The classification system is based on a fire priority rank, a mechanical rank and resources at risk as described below. Much of the criteria for prioritization of restoration treatments used in the Landscape Strategy was incorporated into this classification process. The overall process integrates values for ecological departure, potential severe fire effects, risks to communities and wildlife, and the minimization of implementation impacts in order to provide a classification system for treatments proposed throughout the project area.

Fire Priority Ranking

Four data sets (table 18) were used to identify areas of high probability for severe fire effects and/or behavior. These datasets are crown fire potential, fireline intensity, slopes greater than 40 percent and soils with high erosion hazard. Areas showing active or passive crown fire and high or extreme levels of surface fire in timber fuel models were given points according to the matrix (table 19). Those areas of high probability of crown fire or high intensity surface fire occurring on slopes greater than 40 percent were given one additional point. Additionally, those areas identified on soils with high erosion hazard were given one additional point. The total points possible are 7.

Table 18. Fire prioritization matrix

Crown fire	Active	3	Highest priority. High mortality, good potential for negative surface effects
	Passive	2	
High intensity surface fire	>4000 (extreme)	2	High intensity, high potential for mortality, high likelihood of negative surface impacts.
	1000 – 4000 (high)	1	Indicates flame length >11 ft, not in the highest category for effects. Control limited to indirect attack.
Slope >40%		1	No mechanical option. Increases likelihood of negative impacts to onsite resources (seed bank, soil, etc) as well as potential downslope effects (debris flows, etc)
High Erosion Hazard		1	

Table 19. Fire scoring matrix

Score (1-7)	Fire Attributes
1	high intensity
2	passive crown fire OR extreme intensity OR high intensity + >40% slope OR high intensity + erosion hazard
3	active crown fire OR passive crown fire + >40% slope OR passive crown fire + high intensity OR passive crown fire + erosion hazard
4	passive crown fire + extreme intensity OR passive crown fire + high intensity + >40% slope OR passive crown fire + high intensity + erosion hazard OR active crown fire + >40% slope OR active crown fire + erosion hazard
5	active crown fire +extreme intensity OR active crown fire + high intensity + >40% slope OR passive crown fire + extreme intensity + >40% slope OR active crown fire + high intensity + erosion hazard OR passive crown fire + extreme intensity + erosion hazard OR active crown fire + >40% slope + erosion hazard
6	active crown fire + extreme intensity + >40% slope OR active crown fire + extreme intensity + high erosion hazard
7	active crown fire + extreme intensity + >40% slope + erosion hazard

According to this process, scores of two or greater indicate high probability of severe fire effects/behavior. An average score was calculated for every mechanical treatment stand. Stands with an average score of two or greater and stands with ≥50 acres of high probability of severe effects/behavior (scores between 2 and 7) were identified as high fire priority stands.

Mechanical Treatment Prioritization Ranking

Five data sets were used to create the mechanical rankings. Three of the data sets were based on stand data, one was based on soil strata and one was based on distance from roads. The three stand-based data sets are silviculture priority, timber suitability and age structure. Silviculture priority provides a point (Pt/Pts) rating of the departure from desired conditions based on site class and SDI rating (table 20).

Table 20. Silvicultural prioritization matrix

Silviculture Priority	Silviculture Priority 1 = Site Class 1 or 2 and stand density index (SDI) Rating High	2 Pts
	Silviculture Priority 2 = Site Class 3 and stand density index (SDI) Rating High	1 Pt
Timber Suitability	Timber component in the 500 series (Suitable Timber)	2 Pts
	Timber component in the 600 series (Suitable Timber with a Wildlife emphasis)	1 Pt
Age Structure	Unevenage stand	1 Pt
Soil Strata	Most productive/least competition and mitigations	2 Pts
Roads	¼ mile to maintenance level 3 or 4	2 Pts
	¼ mile to maintenance level 2	1 Pt
Total Possible Points		9 Pts

Resources at Risk

The resources used for this process were wildlife habitat and communities/community watersheds. Wildlife habitat was defined using a ¼-mile southwest buffer from Mexican spotted owl Protected Activity Centers (PACs) and northern goshawk Post Fledgling Family Areas (PFAs). PACs were removed from the actual buffer. The communities and community watershed protection data set created by Forest ERA for use in the landscape strategy was used for this process. The mechanical ranking data set was intersected with the two resources at risk data sets and points were assigned according to the matrix below (table 21).

Table 21. Ranking matrix for resources at risk

	Point Score (1-9)	Risk Rating	Resources at Risk		
			No Resources	Wildlife Or Communities	Wildlife And Communities
Mechanical Treatment Ranking	1-3	Low	1	2	4
	4-6	Moderate	3	5	7
	7-9	High	6	8	9

The average score for each stand was found using the above matrix. Initially, scores of 4 or greater were used to define high ecological restoration value and need (HERVN) stands. Areas with scores in this range indicate greater departure from the natural range of variability, proximity to resources at risk, and greater potential for the minimization of impacts upon implementation. Stands with a score of less than 4 and stands with no mechanical treatments proposed were defined as "moderate ecological restoration value and need" or "MERVN". Additionally, stands with a high fire priority were identified using the fire priority data set. Any ponderosa pine or aspen stand with a possible mechanical treatment identified through that process as high fire priority were automatically given a "high ecological restoration value and need" or "HERVN" designation due to the high possibility of high intensity fire behavior and/or high severity effects. Finally, stands with a proposed mechanical treatment type of grassland restoration or savanna were given a HERVN designation as well.

Further iterative refinements to the classification system were conducted. First, stands with an average score of 3 or greater based on the mechanical ranking and resources at risk matrix were added to the HERVN stands. These stands were not initially included as HERVN because they did not intersect with resources at risk, but were added in because of the higher levels of departure and greater potential for the minimization of impacts upon implementation. The second round of refinement defined large contiguous areas of MERVN stands as "burn only." The last round of refinement changed "no mechanical treatment" stands to "burn only**."**

Appendix E. Glossary of Terms

Age class – A distinct aggregation (grouping) of trees originating from a single natural event commonly consisting of trees of similar age.

Closed Road - Intermittent service roads that are closed to vehicular traffic. However, these roads may be available and suitable for non-motorized uses. The closure period must exceed 1 year. Basic custodial maintenance is performed to keep damage to adjacent resources to an acceptable level and to perpetuate the road to facilitate future management activities. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this maintenance level (USDA Forest Service 2005).

Clump - A tight cluster of two to five trees of similar age and size originating from a common rooting zone that typically lean away from each other when mature. A clump is relatively isolated from other clumps or trees within a group of trees. A stand-alone clump of trees can function as a tree group.

Declining - The senescent (aging) period in the lifespan of plants that (for trees) includes the presence of large dead and/or dying limbs, snag-tops, large, old lightning scars and other characteristics that indicate the later life-stages.

Diversity - The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

Ecological restoration - The process of assisting the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed. Restoration focuses on establishing the composition, structure, pattern, and ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and healthy under current and future conditions (USDA Forest Service 2008).

Even-aged stand - A stand of trees composed of a single age class in which the range of tree ages is usually ±20 percent of rotation (SAF 2008).

Even-aged management – The application of a combination of actions that result in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and, therefore, tree sizes) throughout the forest area. The difference in age between trees forming the main canopy level of a stand usually does not exceed 20 % of the age of the stand at harvest rotation age. Regeneration in a particular stand is obtained during a short period at or near the time that a stand has reached the desired age or size for regeneration and is harvested. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.

Evidence-based restoration – Using indicators of trees standing at the time of settlement that are no longer present as living trees—including snags, downed logs, stumps, and stump holes to guide restoration objectives (ERI 2009).

Fire Regime - The patterns of fire that occur over a long period of time across a landscape vegetation community, and, its immediate effects on the ecosystem in which it occurs. There are five fire regimes which are classified based on frequency (average number of years between fires) and severity (amount of replacement on the dominant overstory vegetation) of the fire. These five regimes are:

- **Fire regime I** – 0 to 35 year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (less than 75 % of dominant overstory vegetation replaced);
- **Fire regime II** – 0 to 35 year frequency and high severity (greater than 75 % of dominant overstory vegetation replaced);
- **Fire regime III** – 35 to 100+ year frequency and mixed severity;
- **Fire regime IV** – 35 to 100+ year frequency and high severity; and,
- **Fire regime V** – 200+ year frequency and high severity.

Forage - Browse and herbage which is available and can provide food for animals or be harvested for feeding; or (2) to search for or consume forage (ITR 1734-4).

Forest Health - The perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance —note perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time (SAF 2008).

Group – A cluster of two or more trees with interlocking or nearly interlocking crowns at maturity surrounded by an opening. The size of tree groups is typically variable depending on forest community and site conditions and can range from fractions of an acre (a two-tree group) to many acres. Trees within groups are typically non-uniformly spaced, some of which may be tightly clumped (SAF 2008).

Group Selection - A cutting procedure which creates a new age class by removing trees in groups or patches to allow seedlings to become established in the new opening (SAF 1998).

Intermediate Thinning - The thinning or cutting of trees to improve the composition, structure, condition, health and growth of remaining trees (SAF, 1998).

Mature Tree – tree that has attained most of its potential height growth.

Over-mature Tree – A tree that has reached that stage of development when it is declining in vigor and health and reaching the end of its natural life span. Indications of later life stages in southwestern ponderosa pine include yellowing bark, large limbs, dead and/or dying limbs, flat tops, snag tops, lightning scars and burn scars (cat face).

Pre-Commercial Thinning – The removal of trees not for immediate financial return but to reduce stocking to concentrate growth on the more desirable trees (SAF 2008).

Regenerate - The act of renewing tree cover by establishing young trees naturally or artificially (SAF 2008).

Resiliency – The capacity of a (plant) community or ecosystem to maintain or regain normal function and development following disturbance (SAF 2008).

Road and Route Obliteration – *see* Road Decommission

Road Decommission -Activities that result in the stabilization and restoration of unneeded roads to a more natural state (36 CFR 212.1, Forest Service Manual 7705 - Transportation System [[USDA FS 2003]]). The Forest Service Manual (FSM 7712.11- Exhibit 01) identifies five levels of treatments for road decommissioning which can achieve the intent of the definition. These include the following: 1. Block entrance, 2. Revegetation and waterbarring, 3. Remove fills and culverts, 4. Establish drainageways and remove unstable road shoulders, 5. Full obliteration, recontouring and restoring natural slopes.

Restoration Unit - a contiguous geographic area that ranges from 46,000 acres to 335,000 acres in size where a need for change (vegetation structure, pattern, spatial arrangement, potential for destructive fire behavior and effects) has been identified. Restoration unit boundaries are based on 6th code watershed boundaries, state and forest transportation systems and forest administrative boundaries

Restoration Sub-Unit: a contiguous geographic area that ranges from 4,000 acres to 109,000 acres in size. Boundaries are based on 6th code watershed boundaries, state and forest transportation systems and forest administrative boundaries.

Road construction or reconstruction - Supervising, inspecting, actual building, and incurrence of all costs incidental to the construction or reconstruction of a road (36 CFR 212.1).

Stand Density –A measure of the degree of crowding of trees within stocked areas commonly expressed by various growing space ratios, e.g., height/spacing (SAF 2008).

Stand Density Index (SDI) – A measure of the stocking of a stand of trees based on the number of trees per unit area and diameter at breast height of the tree of average basal area. It may also be defined as the degree of crowding within stocked areas, using various growing space ratios based on crown length or diameter, tree height or diameter, and spacing. The computed value of SDI is often compared to the species maximum to determine the relative "stand density" or stocking of the stand.

Stand Structure - The horizontal and vertical distribution of components of a forest stand including the height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, snags, and down woody debris (SAF 2008).

Temporary road or trail: A road or trail necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a forest road or trail and that is not included in a forest transportation atlas (36 CFR 212).

Unauthorized road: A road that is not a forest road or a temporary road or trail and that is not included in a forest transportation atlas (36 CFR 212).

Uneven-aged forests - Forests that are comprised of three or more distinct age classes of trees, either intimately mixed or in small groups.

Uneven-aged management - The application of a combination of actions needed to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and, the orderly growth and development of trees through a range of diameter or age classes (to provide a sustained yield of forest products). Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.

Appendix F. Proposed Forest Plan Amendments

Table 22. Proposed Coconino NF and Kaibab NF Non-Significant Forest Plan Amendments

No./Topic	Current Forest Plan Direction	Need for Change Summary	Proposed Amendment Description	Proposed Amendment Language**
Coconino National Forest				
No. 1: Vegetation and prescribed fire treatments within Mexican spotted owl (MSO) PACs	*Harvest conifers less than 9 inches in diameter only within those protected activity centers treated to abate fire risk (Coconino forest plan, p. 65-2) *Use combinations of thinning trees less than 9 inches in diameter mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area activity center outside the 100 acre "no treatment" area." (Coconino forest plan, p. 65-2)	There is a need to enhance nesting, roosting and foraging habitat while reducing the risk of crown fire and high intensity surface fire in at least 18 PACs. There is a need to increase overall tree health, promote the development of larger diameter trees, improve health and longevity of existing old trees, promote faster development of old growth forest structure, improve owl forage and nesting habitat, and reduce the potential effects of wildfire within these PACs. If the harvesting of trees is limited to 9 inch DBH, an insufficient number of pines would be removed. This would result in no measurable improvements	A project-specific Coconino forest plan amendment is proposed to allow for: (1) harvesting of ponderosa pine less than 16 inch dbh outside of the 100-acre no treatment buffer to improve Mexican spotted owl habitat and abate fire risk, and, (2) prescribed fire within the 100-acre no treatment buffer in 18 Mexican spotted owl Protected Activity Centers: Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M and Sawmill Springs.	*Harvest conifers less than 9 inches in diameter only within those protected activity centers treated to abate fire risk as described below, except for the Clark PAC *and Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M and Sawmill Spring where trees less than 16 inches diameter will be harvested.* * Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark, *Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red*

No./Topic	Current Forest Plan Direction	Need for Change Summary	Proposed Amendment Description	Proposed Amendment Language**
		to forest health, growth, and vigor, owl habitat, fire regime condition class, or reduction in fire hazard within the 18 PACs.		*Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M and Sawmill Spring and mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area." except for Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M and Sawmill Spring PACs where prescribed fire will be used within the 100-acre "no treatment" area to abate fire risk.*
No. 2: Post-savanna treatment canopy cover and reserve trees in goshawk foraging habitat	Ponderosa Pine: (1) Canopy Cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5)	Savanna treatments are designed to restore a reference condition based on historic	A project-specific Coconino NF plan amendment to allow for a variance in managing	Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) DELETED *"should"* REPLACED WITH *may average*

No./Topic	Current Forest Plan Direction	Need for Change Summary	Proposed Amendment Description	Proposed Amendment Language**
	should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3-5 trees per group, will be left if the opening is greater than an acre in size (Coconino forest plan, p. 65-10)	characteristics consistent with a ponderosa pine "open" reference condition. The desired condition is to restore pre-settlement grass/forb interspaces andrestore historic forest structure and pattern . Because interspaces would be based on pre-settlement evidence, meeting 40%+ canopy cover in each group (VSS 4 to VSS 6) cannot be guaranteed. Because interspaces would be based on pre-settlement evidence, meeting the reserve tree requirement cannot be guaranteed.	VSS 4 to VSS 6 with a minium of 40 percent canopy cover on 27,177 acres of ponderosa pine goshawk foraging habitat. A project-specific Coconino NFforest plan amendment to allow for less than 3 to 5 residual large trees in all created openings greater than 1 acre in size in lands (post-savanna treatment) to be managed as ponderosa pine open savanna conditions in goshawk foraging habitat.	≤40+%, mature forest (VSS 5) DELETED *"should"* REPLACED WITH *may average* ≤40+%, and old forest (VSS 6) DELETED *"should"* REPLACED WITH *may average* ≤40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. DELETED "*One group of reserve trees, 3-5 trees per group, will be left if the opening is greater than an acre in size"*.
No. 3: Scales of Analysis	Combine compartments to form an identifiable block approximately 10,000 acres in size. A range of 8,000 to 12,000 acres is acceptable. Individual blocks may be larger or smaller if approved by the	Using a scale of analysis at 10,000 acres is meaningless for a project of this size. The 10K block was used as a surrogate as a means to get to a landscape scale of analysis. A 10K analysis	Site-specific Coconino forest plan amendment to allow a variance from applying integrated stand management, wildlife hiding and thermal cover, and HCI standards and guidelines at a 10,000-	(DELETED*: 10,000-Acre Blocks (10K Blocks)* (DELETED*: Combine compartments to form an identifiable block approximately 10,000 acres in size. A range of 8,000 to 12,000 acres is*

No./Topic	Current Forest Plan Direction	Need for Change Summary	Proposed Amendment Description	Proposed Amendment Language**
	Forest Supervisor. Standards and Guidelines are applied on a 10K Block basis rather than on an individual timber sale or project basis. Wildlife habitat objectives for each 10K Block are evaluated on an individual stand basis as well as for the entire block. Evaluate the need for wildlife forage in the 10K Blocks using the Habitat Capability Index, other available data and professional judgment and, where needed, adjust prescriptions to obtain it. These areas are stands of up to 10 acres with reduced GSL (Coconino forest plan, p. 70). Wildlife Cover: Manage for at least 30 percent cover in 10K Blocks (Coconino forest plan, p. 124).	for this project would be too small to use for building up to the landscape and ecosystem scale. A key assumption in using the 10K block was if objectives are being met at the 10K, objectives are being met at the larger scale. There is a need to use scales which allow for meaningful analysis from the small to landscape scale.	acre block scale. Standards and Guidelines would be applied on the following scales of analysis as appropriate: stand (small scale), restoration sub-unit (equates to an EMA), restoration unit (one scale above the EMA), and the ponderosa pine cover type (landscape scale).	*acceptable*.) Individual blocks may be larger or smaller if approved by the Forest Supervisor. DELETED: *Standards and Guidelines are applied on a 10K Block basis rather than on an individual timber sale or project basis* and REPLACED WITH: *Standards and Guidelines are applied on the following scales of analysis as appropriate: stand (small scale), restoration sub-unit (equates to an EMA), restoration unit (one scale above the EMA), and the ponderosa pine cover type (landscape scale).* Minimum Management Requirements are exceeded where it is good multiple-use management to do so, such as greater density of snags adjacent to meadows, riparian

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				areas, and key water sources. DELETED: *Wildlife habitat objectives for each 10K Block are evaluated on an individual stand basis as well as for the entire block and* REPLACED WITH: *Wildlife habitat objectives will be evaluated on an individual stand basis (small scale) and at sub-unit scale (4,000 to 109,000 acres*). DELETED*: Evaluate the need for wildlife forage in the 10K Blocks using the Habitat Capability Index, other available data and professional judgment and, where needed, adjust prescriptions to obtain it.* and REPLACED WITH: Evaluate the need for wildlife forage *at the stand and sub-unit scale* using the Habitat Capability Index, other available data and

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				professional judgment and, where needed, adjust prescriptions to obtain it. These areas are stands of up to 10 acres with reduced GSL. **Wildlife Cover:** Manage for at least 30 percent cover. DELETED *in 10K Blocks and* LANGUAGE ADDED: *The hiding and thermal wildlife cover analysis will be conducted at the stand (average size is 100 acres) to sub-unit scale (4,000 to 109,000 acres).*
Kaibab National Forest				
No. 1: Post-savanna treatment canopy cover and reserve trees in goshawk foraging habitat	Ponderosa Pine: (1) Canopy Cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should	Savanna treatments are designed to restore a reference condition based on historic characteristics consistent with a ponderosa pine "open" reference	A project-specifi Kaibab plan amendment to allow for a variance in managing VSS 4 to VSS 6 with a minium of 40 percent canopy cover on 17,977 acres of	Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) DELETED *"should"* REPLACED WITH *may average* ≤40+%, mature forest (VSS 5) DELETED

No./Topic	Current Forest Plan Direction	Need for Change Summary	Proposed Amendment Description	Proposed Amendment Language**
	average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3-5 trees per group, will be left if the opening is greater than an acre in size (Kaibab forest plan, p. 30)	condition. The desired condition is to restore pre-settlement grass/forb interspaces and restore historic forest structure and pattern. Because interspaces would be based on pre-settlement evidence, meeting 40%+ canopy cover in each group (VSS 4 to VSS 6) cannot be guaranteed.	ponderosa pine goshawk foraging habitat. A project-specific forest plan amendment to allow for less than 3 to 5 residual large trees in all created openings greater than 1 acre in size in lands (post-savanna treatment) to be managed as ponderosa pine open savanna conditions in goshawk foraging habitat.	*"should"* REPLACED WITH *may average* ≤40+%, and old forest (VSS 6) DELETED *"should"* REPLACED WITH *may average* ≤40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. DELETED "*One group of reserve trees, 3-5 trees per group, will be left if the opening is greater than an acre in size"*.

** Proposed changes in forest plan language are displayed with an underline and italics. Language that would be deleted from the forest plan is also identified.